ETRAN

Proceedings of Abstracts and Program

2nd International Conference on Electrical, Electronic and Computing Engineering

IcETRAN 2015

In conjunction with the 59th annual meeting of ETRAN Society

Silver Lake (Srebrno Jezero), Serbia
June 8-11, 2015

Electronics
Telecommunication
Computers
Automations
Nuclear Technique

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Belgrade, June 2015

ETRAN (Formerly: ETAN) is the oldest, the largest and the most prestigious Serbian professional society. It has been organizing the national conference ETRAN in continuation since 1955. Held each year, typically with 300-500 papers, its goal has been to gather in one place researchers from otherwise specialized and diverse fields of electrical and electronic engineering and to ensure their closer contacts and cross-pollination of ideas. The international conference IcETRAN is dedicated to the same topics and intended to extend the event to the international audience. The conference is organized with support of IEEE. The official language of the conference is English.

An Overview of previous ETAN/ETRAN conferences

1.	Beograd, November 1955		31.	Bled, June 1987
2.	Beograd, November 1957		32.	Sarajevo, June 1988
3.	Ljubljana, November 1958		33.	Novi Sad, June 1989
4.	Zagreb, November 1959		34.	Zagreb, June 1990
5.	Beograd, November 1960		35.	Ohrid, June 1991
6.	Sarajevo, November 1961		36.	Kopaonik, September 1992
7.	Novi Sad, November 1962		37.	Beograd, September 1993
8.	Zagreb, November 1963		38.	Niš, June 1994
9.	Bled, November 1964		39.	Zlatibor, June 1995
10.	Beograd, November 1965		40.	Budva, June 1996
11.	Niš, June 1967		41.	Zlatibor, June 1997
12.	Rijeka, June 1968		42.	Vrnjačka Banja, June 1998
13.	Subotica, June 1969		43.	Zlatibor, September 1999
14.	Sarajevo, June 1970		44.	Sokobanja, June 2000
15.	Split, June 1971		45.	Bukovička Banja, June 2001
16.	Velenje, June 1972		46.	Banja Vrućica - Teslić, June 2002
17.	Novi Sad, June 1973		47.	Herceg Novi, June 2003
18.	Ulcinj, June 1974		48.	Čačak, June 2004
19.	Ohrid, June 1975		49.	Budva, June 2005
20.	Opatija, June 1976		50.	Beograd, June 2006
21.	Banja Luka, June 1977		51.	Herceg Novi, June 2007
22.	Zadar, June 1978		52.	Palić, June 2008
23.	Maribor, June 1979		53.	Vrnjačka Banja, June 2009
24.	Priština, June 1980		54.	Donji Milanovac, June 2010
25.	Mostar, June 1981		55.	Banja Vrućica - Teslić, June 2011
26.	Subotica, June 1982		56.	Zlatibor, June 2012
27.	Struga, June 1983		57.	Zlatibor, June 2013
28.	Split, June 1984		58.	Vrnjačka Banja, June 2014
29.	Niš, June 1985		59.	Silver Lake, June 2015
30.	Herceg Novi, June 1986			

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SINGIDUNUM UNIVERSITY, BELGRADE

SCHOOL OF ELECTRICAL ENGINEERING, UNIVERSITY OF BELGRADE

UNDER THE AUSPICES OF

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGICAL DEVELOPMENT
OF THE REPUBLIC OF SERBIA

WITH THE SUPPORT OF

IEEE – INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, USA

ETRAN

Society for Electronics, Telecommunications, Computers, Automatic Control
and Nuclear Engineering

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Niš, June 9, 1967.
    1. Rajko Tomović, honorary president of ETAN/ETRAN

Zadar, June 12,. 1978.
    12 members

Beograd, 1999.
    1. Academician Jovan Surutka
    2. Prof. Dimitrije Tjapkin
    3. Prof. Radoslav Horvat

Belgrade, May 15, 2006.
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    2. Academician Momčilo Ristić
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    13. Prof. Vojislav Aranđelović

Zlatibor, June 4, 2013.
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    2. Prof. Borivoj Lazić
    3. Prof. Dušan Petrovački

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    119 members

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    11. Prof. Miloljub Smiljanić
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    13. Prof. Baldomir Zajc

Zlatibor, June 4, 2013.
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    2. Prof. Aleksandar Nešić

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GENERAL INFORMATION

Time and Venue

IcETRAN 2015 conference is held in Danubia Park hotel, Silver Lake (Srebrno Jezero), Serbia, from Monday, June 8 to Thursday, June 11, 2015.

Registration Fee

Each IcETRAN conference participant with a regular contribution is requested to pay the registration fee with the ETRAN Society. Registration is free for participants with keynote or invited presentations, as well as for the committee members and covers the publication cost of one presentation. IEEE members pay a discounted registration fee.

Normal registration fee	180 €
IEEE members	150 €
Collective members of ETRAN Society:	120 €
Students	75 €
Keynote and invited presenters and committee members	free

Discounted student fee is valid for students of undergraduate studies (up to 24 years of age), master students (up to 27 years) and PhD students (up to 30 years). Proofs must be given on their status in order to enjoy a discounted fee. The 50% discount is valid for a maximum of one paper per participant

A participant with a paid registration fee is eligible for the attendance of all conference events including its social programme with welcome party and conference dinner, as well as for conference materials which include printed abstracts proceedings, a disk with the full texts of proceedings (to be sent to the participant address after the conference). The prices are guaranteed for the payments received before May 31, 2015.

The conference proceedings are published after the conference and are distributed to the participants by mail. If a paper has not been presented at the conference by one of the authors or if a fee according to the above has not been paid, the paper will not be published in the proceedings.

Conference Desk

The registration desk of the IcETRAN conference starts with the work on Monday, June 8, 2015 in 10:00 h in the lobby of the Danubius hotel, Silver Lake.

The registration desk will register participants, administer conference materials, receive registration fees and offer information to participants.

Conference Opening
Monday, June 8, 18:15-20:00
Central Hall

a. Welcome address
b. Introductory speech by ETRAN Society chair Bratislav Milovanović
c. Opening of 59th ETRAN Conference
d. Opening of IcETRAN 2015 Conference
e. Aleksandar Marinčić Award
f. Best Papers Awards

2015 – (UNESCO) Anniversary of Mihajlo Pupin
Presenter: Dušan Drajić, University of Belgrade, Serbia
(in Serbian)
Tuesday, June 9, 11:30-12:00, Kamin Room

Annual General Assembly of ETRAN Society
(in Serbian)
Tuesday, June 9, 19:00-20:00
Central Hall

ROUND TABLE 1: Information-communication technologies (ICT) as the moving force of industrial recovery and growth
(in Serbian)
Tuesday, June 9, 12:00-14:00, Kamin Room
Kamin Room

Annual meeting of Serbian Society for Microwave Technique, Technologies and Systems
(in Serbian)
Tuesday, June 9, 17:00, Room 1C
Chair: Bratislav Milovanović

ROUND TABLE 2: Telekom Srbija as the perpetrator of the development of IC technologies and overal development of Republic of Serbia
(in Serbian)
Tuesday, June 10, 12:30-14:30
Kamin Room

Eleventh Annual Workshop nanoETRAN
(in English)
(within the section for Microelectronic and Optoelectronics)
Chair: Zoran Jakšić
Thurdsay, June 11, 12:30-14:30 h
Room 1A

The nanoETRAN workshop is dedicated to all aspects of nanoscience and nanotechnology related to electronics and electrical engineering, micro and nanoelectronics, micro and nanosystems, photonics and nanophotonics, as well as the aspects of fundamental science related to it. The papers are published in full in IcETRAN conference proceedings.

Science Books Exhibition: Academic Mind Publisher
Conference Lobby, Throughout the conference

Conference closing
Thursday, June 11, 14:30
Kamin Room

IcETRAN Sections

A total of 306 contributions has been accepted for oral presentation at the 59th annual meeting of the ETRAN Society.

159 papers have been accepted for presentation at the IcETRAN 2015 International Conference within 29 sessions of 17 sections:

KS	Keynote Presentations (6)
AKI	Acoustics (5)
API	Antennas and Propagation (4)
AUI	Automatic Control (17)
EEI	Power Engineering (6)
EKI	Electric Circuits and systems and signal processing (12)
ELI	Electronics (9)
MEI	Biomedicine (5)
MLI	Metrology (6)
MOI	Microelectronics and Optoelectronics (11)
MTI	Microwave and Submillimeter Technique (12)
NMI	New Materials (3)
NTI	Nuclear Engineering (5)
ROI	Robotics and Flexible Automation (24)
RTI	Computers (11)
TEI	Telecommunications (11)
VII	Artificial Intelligence (12)

Besides that, 147 papers have been accepted for 59th national conference ETRAN, to be presented within 25 sessions of 14 sections.

Full papers presented at the conference will be published in CD proceedings. In order to be included in the proceedings, a paper accepted for the Conference must be presented by one of the authors and a registration fee must be paid.

Professional Boards may nominate one award each for the best junior researcher paper (graduate or doctoral student). To be eligible for the Award, a junior researcher must be the first author of the paper and must personaly present the paper at the Conference.

Professional Boards may also propose one paper for the Best Paper Award.

A digital projector is available for presentation and a PC computer with Windows XP or Windows 7 operating system, with MS Power Point. It is advised to use lettering of minimum 18 pt in slides.

The talk duration is 30 minutes for keynote presentations and 20 minutes for invited presentations, while regular papers are presented in 12 minutes, followed by max. 3 minutes of discussion.

SESSION CHAIRS

KEYNOTE SESSIONS

KS1   **Tom Kazmierski**
KS2   **Karsten Berns**

CONTRIBUTED SESSIONS

AKI1   **Petar Pravica, Dejan Ćirić**

API1   **Branko Kolunžija**

AUI1   **Branko Kovačević**
AUI2   **Božo Krstajić**
AUI2   **Milan Rapaić**

EEI1   **Evgenije Adžić**

EKI1   **Budimir Lutovac**
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ROI4   **Bojan Nemec, Mirjana Popović**

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RTI1   **Ivan Milentijević**

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VII1   **Aleksandar Perović**
VII2   **Milan Milosavljević**

Invited and Contributed Papers

KEYNOTES – KS

KS1. Keynote Presentations 1
Chair: Tom Kazmierski, University of Southampton,
UNITED KINGDOM
Tuesday, June 9, 2015, 10:30-12:00, Kamin Room

KSI1.1
Keynote paper
CHALLENGES AND SOLUTIONS IN AGRICULTURAL
ROBOTICS

Karsten Berns, Technische Universität Kaiserslautern,
GERMANY

In the year 2050, it is estimated that the world population will be around 9 billon people. Based on limited land and the yearly increase in the number of natural disasters destroying fields, expert expect that the food production must be increased nearly by a factor of two compared to the state of today. For solving this problem, the automation and optimization of agricultural processes must be extended. Agricultural robotics plays a key role for this purpose.

At the moment, automation in farming starts with agricultural vehicles like tractors, sprayers, or harvesters, which are equipped with automatic guidance systems. Based on global navigation satellite systems (GNSS) like the NAVSTAR-GPS and the use of terrestrial correction signals to improve the localization quality up to ±2 cm, simple navigation tasks could be autonomously performed. All these GNSS-based systems have to deal with drawbacks like the localization robustness, missing collision avoidance modules, or the inability to follow existing structures such as orchards, plant rows, and windrows. For cost reduction and for increasing the productivity, driving without a human operator will be necessary. Therefore, agricultural vehicles must be safe – especially in relation to humans.

In the presentation, first the state of the art will be given. Based on the main challenges in agricultural vehicles, the presentation will focus on related research results which have been achieved in the Robotics Research Lab of the University of Kaiserslautern during the last years. Path planning and control methods following structures like windrows will be introduced. Obstacle detection and environmental description algorithms will be discussed according to typical agricultural applications. Safe and reliable operations are essential for autonomous agricultural vehicles. Based on application examples it will be shown how such non-functional features can be fulfilled. The presentation ends with a discussion of some detection methods used to analyze the state of the crops.

KSI1.2
Keynote paper
DISPLACEMENT SENSOR FOR DETECTING SUB-
MICROMETER MOTION

Svetlana Avramov-Zamurović, United States Naval Academy,
USA

Development of new reliable sensors to measure sub-micrometer displacement of moving objects is required by continuous size reduction of state-of-the-art nano-scale devices. The most challenging sensor design requirements are nano application dependent on shape, size of the area for sensor placement and electrical connections. The active sensing area has to be created only by the sensor itself and it cannot incorporate the moving object. Common nano applications involve objects that cannot tolerate additional weight from electrical connections and/or are made from materials that cannot be electrically charged. These limitations lead to the design of a very simple sensor that has a small footprint.

There are several displacement measuring methods. The classical method measures the change in capacitance due to an object moving in the fringing electrical field created by sensor electrodes. Extremely small displacements can also be measured using light sensors with high resolutions, but the measurement system is complex and the resolution is limited by the wavelength of the light used for the measurements.

In this talk measuring the displacement of a moving micro platform is explored in and the prototype of a displacement sensor using a comb pattern for a Micro Electro Mechanical System (MEMS) nanopostioning application development and testing are presented. A sensitivity of 0.001 pF/µm, was achieved while measuring the peak-to-peak motion with a distance between the sensor and the nanopositioner of several micrometers. The active sensitive area of the MEMS sensor was 0.3 mm² demonstrating a small footprint.

KS1. Keynote Presentations 2
Chair: Karsten Berns, Technische Universität
Kaiserslautern, GERMANY
Wednesday, June 10, 2015, 10:30-12:30, Kamin Room

KSI2.1
Keynote paper
ENERGY EFFICIENCY IN THE FUTURE INTERNET

Roberto Bruschi, University of Genoa, ITALY

According to major Telecom operators worldwide, there is a significant need for Future Internet devices and network infrastructures to be more energy-efficient, scalable and flexible, in order to realize the extremely

virtualized and optimized networks needed to effectively and efficiently support a very large number of heterogeneous user-led services. In the computing world, an important recent trend has been the move to energy proportionality, i.e., the goal of having energy expenditure in proportion to the instantaneous (rather than the peak) computational load. This has motivated the adoption of virtualization and cloud computing as methods to deliver software services. These developments save power in computation, but increase the load on datacenter networks and on the Internet that supplies them their data. Thus, the goal of energy proportionality has been extended to datacenter networks and the Internet at large. However, the complex interactions between the energy consumed by virtualized servers, the server farms on which they execute, the datacenter networks that interconnect them, and the wider network from which users access services and data, require a holistic approach to energy efficiency, capable of embracing many different aspects and basic strategies of current ICT and network technologies, where the ultimate overall goal should be the rational usage of all physical resources. In this perspective, energy efficiency (with respect to a non-optimized exploitation of ICT equipment) may be viewed as an indicator of the "health" of the overall computing and networking ecosystem. It reflects the extent of exploitation of computing, storage, and communications hardware capabilities to the degree needed to support the current workload generated by applications at the required Quality of Service/Experience (QoS/QoE) level. In this respect, flexibility and programmability in the usage of physical resources (obviously including the network) come naturally onto the scene as instruments that allow optimal dynamic resource allocation strategies to be really implemented in practice. The goal of such optimization can actually be energy efficiency, but it will be achieved under dynamic adaptation to the quality requirements imposed by running applications.

The talk will explore the state of the art in energy-efficiency in networking and datacenters, and the integration of green technologies in the framework of Software Defined Networking (SDN) and Network Function Virtualization (NFV), as a sustainable path toward the Future Internet stemming from the experience of the European projects ECONET (FP7) and INPUT (H2020).

KSI2.2
Keynote paper
A VISION FOR THE MANY-CORE DREAM

Tom Kazmierski, University of Southampton, UNITED KINGDOM
Matthew Walker, University of Southampton, UNITED KINGDOM

Recent many-core architectures, that is, architectures with hundreds or more cores, suffer from a number of fundamental problems. For one, a one-hundred ARM core system would not fit physically on a SoC that powers a mobile or a tablet device. Many current many-core prototypes use existing ISA cores that have been developed for traditional multi-core processors. However, for a scaleable, ultra-low-energy many-core architecture to be successful new designs are needed that would result in smaller and simpler cores. Additionally, current parallel software is not parallel enough. Most applications running on smartphones do not make effective use of the two or four cores that are available on smartphone processors. In a many-core system, networking issues become difficult to solve due to the need to provide data communication and resource sharing between hundreds of cores. Not only there is a huge number of wires needed between the cores themselves to allow data transfers, but complex switching is required which uses a considerable amount of space and also the communication network consumes a large proportion of the overall energy of the processor.

This talk will investigate the potential of massively parallel architectures with simple, ultra-low energy cores to address the above challenges. In future many-core processor systems some of the benefits offered by small processors might become more significant and outweigh the disadvantages if implemented judiciously.

The talk will discuss an idea to design and implement many processors with simple data networks between the cores. Instead of being standalone processors, each small worker is a coprocessor (application specific accelerator) working in conjunction with a standard multi-core system, employing just a few larger cores. Specially designed programs can make use of the application specific coprocessors and off-load tasks to them. Existing operating systems and software can still run without any modifications on the main multi-core processor but programs can utilise the many-core fabric for computing certain tasks in a more energy efficient way, possibly at a higher performance.

KSI2.3
Keynote paper
NUCLEAR POWER IN THE WORLD: DUSK OR DAWN

Jasmina Vujić, Department of Nuclear Engineering, University of California, Berkeley, California, USA

The first commercial nuclear power plants were built in the early 1960s. The new construction starts peaked in the late 1970s. Two accidents, the 1979 Three Mile Island accident in the US and the 1986 Chernobyl accident in USSR, led to phase-outs, slowdowns and moratoriums in several countries, including the USA. Many predicted that nuclear power is coming to its dusk. However, the need for base-load power and lower electricity prices, excellent performance of operating plants, and worry about fossil fuel emissions and climate change, led to a nuclear revival in early 2000s. The recession of 2007-2008, the focus on renewable sources of electricity, and the 2011 Fukushima Daiichi accident in Japan have resulted in slowdowns, moratoriums and phase-outs in some western countries. For example, Germany decided to close eight nuclear power plants and Japan ordered shutdown of 48 plants for inspection. Many predicted a new dusk for nuclear power. Four years after the Fukushima Daiichi accident and seven years after the last large world recession, the

question reminds: what is to be expected regarding the nuclear power in the future – a dusk or new down?

This paper will review the current status of commercial nuclear power plants in the world, the progress in the advanced reactor designs and small modular reactors, the environmental footprint of nuclear power plants as compared to other sources of electricity, and the issues related to spent fuel and safety of future reactors. Geopolitical strategies in the energy field will be addressed, as well as non-proliferation and regional energy security.

KSI2.4
Keynote paper
INTEGRATION OF ROBOT ASSISTANTS AND ELECTRICAL STIMULATION FOR NEUROREHABILITATION

Dejan Popović, University of Belgrade, Faculty of Electrical Engineering, SERBIA

This presentation is about new personal robot assistants which allow a significantly improved outcome of rehabilitation of humans with upper limbs impairment. These robots provide an immediate hand/arm functioning, but also result with therapeutic (carry-over) effects. These systems contribute to the functioning of patients after central nervous system having paretic or paralyzed upper limbs because they provide a desired controlled haptic assistance that is integrated into the preserved sensory-motor systems. These systems are hybrids: they integrate a multichannel functional electrical stimulation providing the grasp/ release and the robot assistant. The hybrid system increases the motivation to exercise, activate afferent nerves and contribute to the changes in the cortical excitability and cortical plasticity. The modularity allows the use of components instead of the whole system based on the level of impairment. These systems implement control that integrates learning from examples allowing a clinician to set the level of assistance during the treatment; thereby, the treatment can be adjusted to fit to the level of impairment. Humans after a stroke are the major beneficiaries from the system but other disabled humans could also benefit (e.g., CP, tetraplegia, surgery recovery). The performance of the system was validated in case series in the clinical environment.

ACOUSTICS – AKI

AKI1. Audio signals, Speech, Room acoustics
Chairmen: Petar Pravica, School of Electrical
Engineering, University of Belgrade, Belgrade, Serbia;
Dejan Ćirić, Faculty of Electronic Engineering,
University of Niš, Niš, Serbia
Monday, June 8, 2015, 11:00-13:00, Room 1A

AKI1.1
Invited paper
APPLICATIONS OF SOUND FIELD ANALYSIS AND
SYNTHESIS IN 3D AUDIO CONTEXT

*Olivier Warusfel, Institut de Recherche et Coordination
Acoustique/Musique (IRCAM), Paris, FRANCE*

The recent development of massive arrays of
microphones or loudspeakers has stimulated numerous
studies on sound field analysis and synthesis together
with the development of 3D audio applications that offer
a refined auditory experience. Advanced 3D audio
techniques such as High Order Ambisonics (HOA) or
Wave Field Synthesis (WFS) rely on large arrays of
loudspeakers distributed on the room boundaries. The
radiation properties of a sound source may be simulated
by digitally controlled spherical loudspeaker arrays
(LSA). On the recording side, spherical microphone
arrays (SMA) are used to capture a soundscape or a
musical ensemble performance with high spatial
resolution. In room acoustics, high-resolution sound field
characterization can be achieved by measuring directional
room impulse responses (DRIR) that combine
microphone and loudspeaker arrays. The measured
DRIRs may be then exploited in convolution-based
reverberators for the auralization of room acoustics with
faithful rendering of its spatial attributes or for 3D audio-
mixing applications. In this particular context, the sound
engineer will typically want to fine tune the perceptual
attributes of the original DRIRs in order to better fit the
aesthetic of the mixing. Such parametric control first
requires the development of an analysis-synthesis
framework that operates on a space-time-frequency
representation of the DRIRs. The theoretical and
perceptual properties of these spatialization techniques are
presented and illustrated in various contexts ranging from
music performance, post-production and broadcast to
virtual reality applications. Meanwhile, the ever-growing
expansion of mobile devices calls for the deployment of
broadcast solutions able to deliver 3D audio content and
that allow for a personalized binaural rendering over
headphones on the end user side.

AKI1.2
FAULT DETECTION IN INDUCTION MOTORS USING
MICROPHONE ARRAYS

*Miloš Bjelić, School of Electrical Engineering, University of
Belgrade, Belgrade, SERBIA*

*Bogdan Brković, School of Electrical Engineering, University
of Belgrade, Belgrade, SERBIA*
*Miodrag Stanojević, School of Electrical Engineering,
University of Belgrade, Belgrade, SERBIA*

Three-phase induction motors are nowadays used in a
wide area of commercial and industrial applications. It is
therefore of the essence to properly monitor the state of
induction motors during their operation, in order to
prevent costly damage due to mechanical and/or electrical
faults. In this paper, the potential of using microphone
arrays as a tool for fault identification in an induction
machine is discussed. Experimental results have
confirmed that, even in a noisy environment, it is possible
to isolate the fault specific harmonics generated by the
motor. The work presented here is focused mainly on
rotor cage faults, although the method can be further
extended to cover a variety of faults associated with
induction motors.

AKI1.3
MULTIMODAL SPEECH RECOGNITIONS BASED ON
THE GFCC FEATURES

*Branko R. Marković, Technical College, Computing and
Information Technology Department, Čačak, SERBIA*
*Slobodan T. Jovičić, School of Electrical Engineering,
University of Belgrade, Belgrade, SERBIA*
*Jovan Galić, Faculty of Electrical Engineering, University of
Banja Luka, Banja Luka, BOSNIA AND HERZEGOVINA*
*Djordje T. Grozdić, School of Electrical Engineering,
University of Belgrade, Belgrade, SERBIA*

In this paper we will show the results of recognition for
multimodal speech using the GFCC features and DTW
method. The isolated words used for this experiment are
from the Whi-Spe database. Three subsets of this database
which contains words of colours, words of numbers and
acoustically balanced words are taken in consideration.
The experiments are focused on normal and whisper
modes and their combinations. The results are divided in
those where the CMS is applied and where is not. They
are presented in forms of tables and diagrams.

AKI1.4
EFFECTS OF SUB-BAND CODING WITH QUASI-
LOGARITHMIC QUANTIZERS ON CHARACTERISTICS
OF AUDIO SIGNALS

*Stefan Tomić, Faculty of Electronic Engineering, University
of Niš, Niš, SERBIA*
*Milan Tančić, Faculty of Electronic Engineering, University
of Niš, Niš, SERBIA*
*Dejan Ćirić, Faculty of Electronic Engineering, University of
Niš, Niš, SERBIA*
*Zoran Perić, Faculty of Electronic Engineering, University of
Niš, Niš, SERBIA*

One of widely accepted schemes for signal compression
is a sub-band coding. In this paper, the effects of such

coding with quasi-logarithmic quantizers on characteristics of audio signals are analyzed. A special focus is on spectral and spectrogram analysis where the changes introduces by the sub-band coding are considered. Besides, for signal coding, signal to quantization noise ratio (SQNR) is given as an objective measure. SQNR of the sub-band coding is compared with SQNR of PCM and the results are shown.

AKI1.5
TRUNCATION OF ROOM IMPULSE RESPONSE BY APPLYING DECAY MODEL

Dejan Ćirić, Faculty of Electronic Engineering, University of Niš, Niš, SERBIA
Marko Janković, Faculty of Electronic Engineering, University of Niš, Niš, SERBIA

Various procedures have been proposed for truncation of a room impulse response at the knee in order to increase the dynamic range of the corresponding decay curve obtained by the backward integration of the response. In this paper, a procedure for the response truncation based on a model of room impulse response (decay model) is presented. The model takes into account both the exponential decay and noise. Unknown parameters of the model are calculated by minimizing the difference between the curve generated by the model and the target one of the response to be truncated. Different curves can be applied in the minimization – the room impulse response itself, the Schroeder curve obtained by backward integration of a room impulse response and logarithmic decay curve. The proposed procedure is tested on various impulse responses (synthesized and measured).

ANTENNAS AND PROPAGATION – API

API1. Antennas and Propagation
Branko Kolundžija, School of Electrical Engineering,
University of Belgrade, Belgrade, Serbia
Monday, June 8, 2015, 14:00-16:00, room 1C

API1.1
Invited Paper
DIAPHRAGMS IN RECTANGULAR WAVEGUIDE: AN
APPROACH BASED ON SINGULAR INTEGRAL
EQUATION

Dragan Filipović, Faculty of Electrical Engineering
University of Montenegro, Podgorica, MONTENEGRO

In this paper some elementary facts about singular
integral equations and related topics are presented and
used to analyze diaphragms in a rectangular waveguide.
Simple, but accurate enough, formulas for diaphragm
susceptance are obtained and some numerical examples
are given for a comparison with the results obtained from
more accurate formulas.

API1.2
LIGHTNING CORONA SHEATH EVOLUTION IN THE
PRESENCE OF THE CURRENT GROUND
REFLECTIONS DURING THE RETURN STROKE

Milan Ignjatović, School of Electrical Engineering,
University of Belgrade, Bulevar kralja Aleksandra 73, 11120
Belgrade, SERBIA
Jovan Cvetić, School of Electrical Engineering, University of
Belgrade, Bulevar kralja Aleksandra 73, 11120 Belgrade,
SERBIA
Milica Tausanović, PD Elektrodistribucija Beograd d.o.o,
SERBIA
Dragan Pavlović, School of Electrical Engineering,
University of Belgrade, Bulevar kralja Aleksandra 73, 11120
Belgrade, SERBIA
Nikola Mijajlović, School of Electrical Engineering,
University of Belgrade, Bulevar kralja Aleksandra 73, 11120
Belgrade, SERBIA
Radivoje Djurić, School of Electrical Engineering, University
of Belgrade, Bulevar kralja Aleksandra 73, 11120 Belgrade,
SERBIA
Milan Ponjavić, School of Electrical Engineering, University
of Belgrade, Bulevar kralja Aleksandra 73, 11120 Belgrade,
SERBIA
Dragana Šumarac Pavlović, School of Electrical
Engineering, University of Belgrade, Bulevar kralja
Aleksandra 73, 11120 Belgrade, SERBIA

The appearance of the overcompensated positive electric
field in the most of very close vertical field measurements
(0.1 m from the channel core) is explained using the
extended generalized lightning traveling current source
return stroke model with the current reflections from the
ground. The channel-base current is separated into two
components. The first one is fast component with a
greater current peak and the second one is slower, with a

smaller current peak. While the first current component,
having a peak value over 15 kA reflects from the perfect
ground with the reflection coefficient equals one, the
second current component, having a peak value well
below 15 kA reflects with the reflection coefficient
smaller than one. As a result, transient negative line
charge density appears along the channel core near
ground enhancing the negative radial electric field in the
channel sheath. This field forces the overcompensated
positive charges to move into the corona sheath to satisfy
the boundary condition on the surface of zone 1. They
remain there after the return stroke current has passed its
peak.

API1.3
PERFORMANCE ANALYSIS OF CAPON-LIKE
ALGORITHM APPLIED ON CONFORMAL ANTENNA
ARRAYS IN SMART ANTENNA SYSTEMS

Andrija Djukić, Faculty of Electrical Engineering University
of Montenegro, Podgorica, MONTENEGRO
Ana Jovanović, Faculty of Electrical Engineering University
of Montenegro, Podgorica, MONTENEGRO
Luka Lazović, Faculty of Electrical Engineering University of
Montenegro, Podgorica, MONTENEGRO

A performance study of Capon-Like algorithm
implemented on conformal antenna array, i.e.
implemented on cylindrical and spherical antenna array is
presented in this paper. In simulations we studied the
influence of different angles of arrival, number of
elements and number of samples on algorithm behavior
with a goal to find the best performance for direction of
arrival estimation.

API1.4
CIRCULARLY POLARIZED PARABOLIC ANTENNA
WITH CAVITY BACKED PRINTED ANTENNA AS A
PRIMARY FEED

Ivana Radnović, IMTEL Komunikacije a.d, Bulevar Mihajla
Pupina 165b, 11070 Belgrade, SERBIA
Aleksandar Nešić, IMTEL Komunikacije a.d, Bulevar
Mihajla Pupina 165b, 11070 Belgrade, SERBIA
Dušan Nešić, IHTM-CMTM, University of Belgrade,
Njegoševa 12, 11000 Belgrade, SERBIA
Bratislav Milovanović, Univerzitet Singidunum, Niš, Nikole
Pašića 28, 18000 Niš, SERBIA

The paper introduces circularly polarized parabolic
reflector antenna with printed antenna consisting of
orthogonally crossed dipoles in the cylindrical cavity
(CBACP) as a primary feed. Circular polarization of the
primary feed is obtained by designing the printed dipoles
to have complex-conjugated impedances while the cavity
provides isolation from surroundings, reduced backward
radiation and higher efficiency of the primary feed as well
as higher gain of the whole antenna system. Dipoles are
fed by a symmetrical (balanced) microstrip line

terminated with a bal-un and a coaxial SMA connector. Presented CBACP enables overcoming various disadvantages of commonly used feeds for parabolic reflector antennas (helices, horn antennas, patches and spiral antennas). Simulated results in the frequency range from 5.7 GHz to 6.3 GHz show very good antenna characteristics: gain of more than 31 dBi, radiation pattern with narrow beamwidth (~3º), reflection coefficient S11 better than -15 dB (VSWR < 1.4), axial ratio (AR) less than 3 dB in 9.8% of the bandwidth around the central frequency, sidelobe attenuation better than 28 dB and front-to-back ratio over 30 dB. According to the authors' knowledge, structures such as presented CBACP used as a primary feed in a parabolic reflector have not been reported so far.

AUTOMATIC CONTROL – AUI

AUI1.1
Invited Paper
CONTROLLING MULTIPLE AGENTS WITH MULTIPLE OBJECTIVES

Dušan M. Stipanović, Coordinated Science Laboratory and the Department of Industrial and Enterprise Systems Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA
Ali Abbas, Industrial and Systems Engineering and Public Policy, University of Southern California, Los Angeles, California, USA
Aleksandar Zatezalo, Scientific Systems Company, Inc., Woburn, Massachusetts, USA

The challenges of controlling multiple agents with multiple objectives are not only related to but include problems in multi-player dynamic games, multi-objective optimization, and decentralized control and estimation. The additional complexity is introduced through agents' dynamic models with possible nonlinearities, delays and perturbations as well as various state, input and communication constraints. In this talk we will present a number of results related to control and coordination of multi-agent dynamic systems with multiple objectives. As an illustration, some particular examples of multiple agent systems achieving multiple objectives such as guaranteed capture or evasion, collision avoidance, coverage control, proximity, and tracking, will be presented.

AUI1.2
LICENSE PLATE CHARACTER RECOGNITION BASED ON HOPFIELD NETWORKS

Nikola Cimbaljević, School of Electrical Engineering, University of Belgrade, SERBIA
Aleksandra Marjanović, School of Electrical Engineering, University of Belgrade, SERBIA
Goran Kvaščev, School of Electrical Engineering, University of Belgrade, SERBIA

A new approach for character recognition in the new licence plates in Republic Serbia, based on the use Hopfiledovih networks, is presented in the paper. Simple structure of Hopfield networks ensure an efficient implementation. However, successful application of the networks requires a proper position of the plates in the image. Consequently, significant effort for a quality image pre-processing must be done for satisfactory classification results. Some of these efforts, based on image segmentation, are presented in the paper, together with practical classification results.

AUI1.3
IMPROVED MATRIX CUSUM TEST FOR THE RECURSIVE SEQUENTIAL TESTING OF MULTIPLE HYPOTHESES

Predrag Tadić, School of Electrical Engineering, University of Belgrade, SERBIA
Sanja Vujnović, School of Electrical Engineering, University of Belgrade, SERBIA
Željko Djurović, School of Electrical Engineering, University of Belgrade, SERBIA

A standard tool for recursive sequential multiple hypotheses testing is the so-called matrix CUSUM test. We show that, in its original form, it can fail completely in some situations and propose a simple modification of the algorithm to eliminate this problem. Monte Carlo computer simulation testify to the effectiveness of the proposed solution.

AUI1.4
DISTRIBUTED BLIND CALIBRATION OF SENSOR NETWORKS: AN ASYNCHRONOUS ALGORITHM

Miloš Stanković, Innovation Center, School of Electrical Engineering, University of   Belgrade
Srđan Stanković, School of Electrical Engineering, University of Belgrade, SERBIA
Karl Henrik Johansson, ACCESS Linnaeus Center, School of Electrical Engineering, KTH Royal Institute of Technology, Stockholm, SWEDEN

In this paper a novel distributed algorithm for asynchronous blind macro-calibration in sensor networks under noisy measurements is proposed. The algorithm is formulated as a set of instrumental variable type recursions for estimating parameters of sensor calibration functions. It is proved using asynchronous stochastic approximation arguments that the algorithm achieves asymptotic consensus for sensor gains and offsets in the mean square sense and with probability one.

AUI1.5
APPLICATION OF SLIDING INTEGRAL ALGORITHM FOR PARAMETRIC FAULT DETECTION OF AN DC MOTOR AMPLIFIER

Sanja Antić, Faculty of Technical Sciences Čačak, Univesity of Kragujevac, SERBIA
Željko Djurović, School of Electrical Engineering, University of Belgrade, SERBIA

In the paper detection and isolation of multiplicative faults by parameter estimation from the continuous-time model is discussed. The technique used was sliding integral algorithm based on finite integration over a sliding window. Since input signal needs to be

persistently exciting pseudo random binary sequence (PRBS) was used. Although the technique is designed for linear and stationary systems it was shown that it can be successfully implemented on a non-linear non-stationary system such an observed electronic amplifier of a DC motor.

AU1.6
DATA CENTRALITY COMPUTATION: IMPLEMENTATION AND COMPLEXITY CALCULATION

Milica Bogićević, School of Electrical Engineering, University of Belgrade, SERBIA
Milan Merkle, School of Electrical Engineering, University of Belgrade, SERBIA

Multivariate medians can be considered as data centrality, i.e. as a data set that is placed in the center of the data cloud.Its usage is very important in distribution-free methods. Data centrality computation is very demanding even for low dimension datasets. In this paper we are presenting an algorithm and its implementationfor data centrality calculation. The algorithm complexity is where is the data set size and is the number of dimensions. Experiments show that algorithm is much faster than other implemented algorithms and it can accept thousands of multidimensional observations, since the other algorithms are tested with many two-dimensional observations or with a couple of hundreds multidimensional observations.

AUI2. Digital signal processing with applications
Chairman: Božo Krstajić, University of Podgorica, Montenegro
Wednesday, June 10, 2015, 8:30-10:30, Room 1B

AUI2.1
SPEECH SIGNAL PARAMETER IDENTIFICATION USING ADAPTIVE FORGETTING FACTOR

Slobodan Drašković, School of Electrical and Computer Engineering of Applied Studies, Belgrade, SERBIA
Goran Kvaščev, School of Electrical Engineering, University of Belgrade, SERBIA
Željko Djurović, School of Electrical Engineering, University of Belgrade, SERBIA
Vera Petrović, School of Electrical and Computer Engineering of Applied Studies, Belgrade, SERBIA
Branko Kovačević, School of Electrical Engineering, University of Belgrade, SERBIA

When modeling a non-stationary signals, such as speech, using autoregressive models it is of utmost importance that the algorithm is sensitive to abrupt changes in model parameters, which achieved by using a forgetting factor in parameter estimation algorithms. These changes usually occur in a speech signal between phonemes, and they are particularly useful in voice segmentation. In order to detect and track these changes we used a method for adaptation of the forgetting factor based on absolute finite differences and compared it to the results acquired using fixed forgetting factor. Using simulations, it will be shown that this adaptive method has better tracking capabilities than the conventional one, at the cost of slightly higher computational effort.

AUI2.2
APPLICATION OF CONTROL CHARTS ON ANALYSIS OF CONDITIONS FOR INFLAMMATION OF THE AIR-FUEL MIXTURE IN THE CYLINDERS OF THE GASOLINE INTERNAL COMBUSTION ENGINE

Emilija Kisić, School of Electrical and Computer Engineering of Applied Studies, Belgrade, SERBIA
Dejan Matijević, School of Electrical and Computer Engineering of Applied Studies, Belgrade, SERBIA
Vera Petrović, School of Electrical and Computer Engineering of Applied Studies, Belgrade, SERBIA

Strict ecology requirements and high performance demands for modern motor vehicles impose the need from the manufactures of the gasoline engines for implementation of sophisticated and high efficient electronic ignition systems. Ignition spark as the initial heat source has to keep values of its parameters in an optimal range. One of these parameters with strong influence on mixture combustion, under all non-stationary conditions, is ignition voltage. The paper provides an analysis based on values of ignition voltages, measured on secondary side of ignition coils, by application of control charts, with the purpose of determination and evaluation of conditions in the cylinders of the engine. This analysis shows how different disturbances in the system influence on ignition voltage with perspective of future upgrading for the assessment of ignition system reliability. A discussion of advantages and shortcomings of the proposed method is given.

AUI2.3
MULTIOBJECTIVE APPROACH TO OPTIMAL WAVEFORM DESIGN FOR SOLID-STATE VHF PULSE-DOPPLER AIR SURVEILLANCE RADAR

Miloš Jevtić, Institute Mihajlo Pupin Belgrade, SERBIA
Nikola Zogović, Institute Mihajlo Pupin Belgrade, SERBIA
Stevica Graovac, School of Electrical Engineering, University of Belgrade, SERBIA

Solid-state transmitters (SST) and Pulse-Doppler (PD) processing are increasingly used in modern VHF air surveillance radars. Typically, low pulse repetition frequency (PRF) regime is chosen, ensuring unambiguous range measurements, while Doppler ambiguities are inevitable, leading to existence of blind speeds. Low peak power inherent to SST mandates the use of long pulses which causes significant range eclipsing. To ensure coverage of all ranges and velocities of interest, a complex waveform consisting of pulses with different durations repeated at multiple PRFs is required. For a set number of coherent processing intervals (CPI) within a dwell, and assuming that pulse durations are same in all CPIs, design variables determining the PD waveform are pulse durations, and PRFs for each CPI. Design goals are

maximization of detection range and efficient mitigation of blind speeds. We show that design goals are conflicting with respect to variation of design variables, and that a multiobjective approach is needed to find the optimal design. We propose an approach with a posteriori articulation of preferences, and illustrate it with an example.

AUI2.4
DESIGN AND PERFORMANCE ANALYSIS OF THE PROPOSED SQUELCH ALGORITHM

Ina Masnikosa, Institute Mihajlo Pupin Belgrade, SERBIA
Stefan Stojkov, Institute Mihajlo Pupin Belgrade, SERBIA

Squelch is used in radio receivers in order to suppress the noise when no audio signal is present. This paper presents software implementation of squelch algorithm and gives its performance analysis. The algorithm includes multiple states with the aim to achieve better recognition between speech and noise segments of the received signal. It is based on the estimation of the signal power which is used to determine the presence of the speech signal. Development of the squelch system, signal processing and displaying of the results is implemented in C++ programming language. During the analysis, several parameters of the system were considered and the optimal values were found. The database of the speech signals was used for the purpose of testing and the system has shown satisfactory results.

AUI2.5
CHALLENGES IN EMOTION SPEECH RECOGNITION

Milana Milošević, School of Electrical Engineering, University of Belgrade, SERBIA
Željko Djurović, School of Electrical Engineering, University of Belgrade, SERBIA

Speech emotion recognition as area of research in speech processing is generally analyzed by several reviews of literature and state of art papers. However there is no integral analysis of opened issues and decisions made by researches which can be discussed. This paper aims to cover opened issues and challenges in this research area. Opened questions are discussed by steps in process of emotional speech recognition which is following: emotional modeling, database construction, feature extraction and selection, classifier selection and application, and validation of results. For every step, several problems are addressed.

AUI3. Different aspects of system control
Chairman: Milan Rapaić, University of Novi Sad, Serbia
Thursday, June 11, 2015, 8:30-10:30, Room 1B

AUI3.1
AN AIMNC FOR THE TYPICAL INDUSTRIAL PROCESSES

Jasmin Igić, Mtel a.d. Banja Luka, BOSNIA AND HERZEGOVINA
Milorad Božić, Faculty of Electrical Engeneering, University of Banja Luka, BOSNIA AND HERZEGOVINA
Igor Krčmar, Faculty of Electrical Engeneering, University of Banja Luka, BOSNIA AND HERZEGOVINA

In this paper, an application of the Approximate Internal Model-based Neural Control (AIMNC) in the control of typical industrial processes is discussed. The considered control strategy utilizes only one neural network (NN), which is the neural model of the plant, and it should be trained off-line. An inverse neural model controller is obtained directly from the neural model, without need for further training. Results of simulations, in which the AIMNC strategy, fixed and adaptive IMC algorithms were applied in control of double tank system, shows that the AIMNC strategy has the best performance indices.

AUI3.2
A NEW METHOD FOR APPROXIMATION OF NON-RATIONAL TRANSFER FUNCTION OF CONTROLLERS WITH UNSTABLE DIPOLES

Marko Bošković, Faculty of Electrical Engineering East Sarajevo, BOSNIA AND HERZEGOVINA
Tomislav B. Šekara, Faculty of Electrical Engineering Belgrade, SERBIA
Milan R. Rapaić, Faculty of Technical Sciences Novi Sad, SERBIA
Boris Jakovljević, Faculty of Technical Sciences Novi Sad, SERBIA

This paper presents a simple and an effective approximation method to obtain rational transfer function of controllers with unstable dipoles. Solution to this problem is based on overlapping of frequency characteristics in discrete frequency points. This method makes possible to design complex controllers for unstable industrial processes with transport delay under constraints on robustness and performance. The comparative analysis with several rational approximation techniques is presented. The effectiveness of the proposed procedure is verified with numerical simulations of typical representatives of unstable processes, including dead-time.

AUI3.3
CONTROL OF A THERMAL PROCESS PHYSICAL MODEL WITH SIMATIC S7-1200 INDUSTRIAL CONTROLLER

Milan Ristanović, Faculty of Engineering, University of Kragujevac, SERBIA
Milan Ignjatović, Faculty of Engineering, University of Kragujevac, SERBIA

In this paper a technical solution of a thermal process physical model is presented. The physical model consists of a blower, electrical heater and temperature sensors. The process is considered as a first order system and appropriate mathematical model is developed. A compact industrial controller controls the process model. Blower

and heater are controlled by PWM signals, while the blower's speed is measured. For the purpose of signal conditioning appropriate drivers and signal conditioners have been developed. A functional block PID control is used to control the air temperature. Parameter of the PID controller is tuned by a sefltuner.

AUI3.4
AN FPGA-BASED DESIGN OF ANTENNA SUBSYSTEM CONTROL UNIT FOR DIDACTIC RADAR

Momir Stanković, Military Academy, University of Defence, Pavla Jurišića Šturma 33, 11000 Belgrade, SERBIA
Stojadin Manojlović, Military Academy, University of Defence, Pavla Jurišića Šturma 33, 11000 Belgrade, SERBIA
Slobodan Simić, Military Academy, University of Defence, Pavla Jurišića Šturma 33, 11000 Belgrade, SERBIA
Milica Naumović, Faculty of Electronic Engineering University of Niš, SERBIA

In this paper, the design of advanced antenna subsystem control unit for didactic radar is presented. It consists of three modules: microwave switches drive unit, servo drive unit and communication controller. The first module controls microwave switches and enables multiplexing of the receiving RF channels. The second module provides control of three-axis platform on which the receiving antennas are mounted. Communication module is realized as an Ethernet Rx controller making whole design is programmable over LAN. The complete control unit is designed and tested in System Generator and Xilinx ISE design tool and implemented on FPGA. In both drive modules the H-bridges as fast and power driving components are used. The proposed design is experimental verified.

AUI3.5
REMOTE CONTROL OF LEGO MINDSTORMS NXT MOTORS PROGRAMMED IN PYTHON

Nikola Jović, Faculty of Engineering, University of Kragujevac, SERBIA
Vladimir Cvjetković, Faculty of Engineering, University of Kragujevac, SERBIA

Milan Matijević, Faculty of Engineering, University of Kragujevac, SERBIA

Technical solution for control of Lego Mindstorms NXT motors using NXT Python library for correction of some NXT Python flaws found in previous versions, is presented in this paper. Educational potential of technical solution which is also used in NXT Web Laboratory is demonstrated. Application of approach described in this paper offers many benefits such as financial savings and greater educational potential comparing to using of software tools like LabVIEW and Matlab

AUI3.6
SCADA APPLICATION FOR CONTROL AND MONITORING OF VIBRATORY FEEDER

Petar Mišljen, Faculty of Engineering, University of Kragujevac, SERBIA
Radomir Mitrović, Faculty of Engineering, University of Kragujevac, SERBIA
Željko Despotović, Faculty of Engineering, University of Kragujevac, SERBIA
Milan Matijević, Faculty of Engineering, University of Kragujevac, SERBIA

In this work was described a SCADA application, which controls the operation of the electromagnetic resonant vibratory feeder. The control unit of the feeder, based on the given parameters, generates electrical impulses to excites electromagnetic vibratory actuator. Electric power converter works on the principle of width-pulse modulation called "PWM". Frequency of the current pulses is equal to the resonant frequency of the feeder, thus achieving maximum material flow with minimal energy consumption and minimal mechanical stress springs (minimum reverse channel in the horizontal plane). PLC, based on the signal from the weight sensor of the metered material and on the basis of the control law, generates a control signal A[%]. The control unit of the feeder excites electromagnetic drive with the energy that is proportional to the value of the signal A[%]

POWER ENGINEERING – EEI

EEI1. Power Engineering I
Chairman: Evgenije Adžić, Faculty of Technical Sciences,
University of Novi Sad, Serbia
Thursday, June 11, 2015, 8:30-10:30, Room 2

EEI1.1
GENERALIZED PSO BASED ENERGY EFFICIENCY CONTROL FOR HIGH SPEED IM DRIVES

Marko Gecić, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Mirna Kapetina, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Vladimir Popović, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Darko Marčetić, Faculty of Technical Sciences, University of Novi Sad, SERBIA

This paper presents an algorithm for minimization of controllable power losses which occur during the electrical to mechanical conversion. In particular, the algorithm generates optimal flux reference based on particle swarm optimization (PSO) and as result increases the energy efficiency of high speed induction motor (IM). The algorithm is tested for different speed and load conditions and simulation results are presented..

EEI1.2
SMART SCADA SYSTEM FOR SMART GRID MONITORING

Josif Tomic, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Zoltan Corba, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Vladimir Katic, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Miodrag Kušljevic, Termoelektro Enel AD, Belgrade, SERBIA

The conventional electrical grid is a network that acts as a link for transmission, distribution and control of electrical power from power producers to consumers. Industrialization and increasing population necessitates the demand for a resourceful and reliable power grid. Smart Grid helps the power utilities and grid to have a digital intelligence to the power system network. Smart Grid comes with smart metering techniques, digital sensors, intelligent control systems with analytical tools to automate, monitor and control the twoway flow of energy during the operation from power to plug. This paper discusses general aspects of Smart Grids and focuses on some distribution level Smart Grid features, such as interconnection of distributed generation and active distribution management, using automated meter reading systems. SCADA (Supervisory Control and Data Acquisition) is an essential infrastructure for this evolution. LabVIEW program significantly simplifies this task as a result of its exceptional flexibility and a large number of pre-written subroutines for a large number of industrial networks and protocols.

EEI1.3
VOLTAGE DIPS SIMULATIONACCORDING TOCIGRE/CIRED/UIE JOINT WORKING GROUP C4.110

Marija Markovska, Faculty of Electrical Engineering, Ss Cyril and Methodius University-Skopje, MACEDONIA
Živko Kokolanski, Faculty of Electrical Engineering, Ss Cyril and Methodius University-Skopje, MACEDONIA
Vladimir Dimčev, Faculty of Electrical Engineering, Ss Cyril and Methodius University-Skopje, MACEDONIA
Dimitar Taskovski, Faculty of Electrical Engineering, Ss Cyril and Methodius University-Skopje, MACEDONIA

Obtaining information for voltage dips that occur in power systems is important for better understanding of their characteristics and their impact on the end-user equipment.

This paper represents an application for simulation and generation of different types of voltage dips caused by short circuit faults that may occur in power systems, using Matlab/GUI. The input parameters of the application are based on the method of segmentation. They provide simulation of user-defined dips as well as automatic creation of voltage dips database for a certain dip type proposed by CIGRE/CIRED/UIE Joint Working Group C4.110. The database offers new insights about the relation between different dip types caused by short circuit faults.

EEI1.4
RENEWABLE ENERGY APPLICATIONS DEVELOPMENT USING CONTEMPORARY HARDWARE AND SOFTWARE TOOLS

Zoran Ivanović, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Marko Vekić, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Evgenije Adžić, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Stevan Grabić, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Vlado Porobić, Faculty of Technical Sciences, University of Novi Sad, SERBIA

As utilization of photovoltaic and wind energy systems gain importance day by day, training seminars and short and online courses are more and more available. In this paper we introduced a new framework aimed to teach students, researchers and wide community users basic and advanced design steps in the field of renewable energy in a virtual environment. It is based on contemporary hardware-in-the loop technique which is used to emulate

electrical power stage of renewable energy applications, while the controller is real. Two most employed renewable energy applications will be covered: wind and photovoltaic. It will be shown process of control algorithm development, integration to the electrical grid and impact of grid disturbances on energy production. The both applications can be accessed remotely by wide range of community users.

EEI1.5
PARAMETER MISMATCH IMPACT ON VECTOR CONTROLLED INDUCTION MACHINE DRIVE WITH CURRENT RECONSTRUCTION METHOD

Evgenije Adžić, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Vlado Porobić, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Zoran Ivanović, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Marko Vekić, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Vladimir Katić, Faculty of Technical Sciences, University of Novi Sad, SERBIA

This paper deals with sensorless induction motor drive control method which uses only dc-link current measurement as a feedback signal. It presents improved current reconstruction method which gives less distorted three-phase current signals necessary for closing current control loop in vector controlled drives. Proposed method is based on machine mathematical model which indicates that method has to be verified in cases where there is a parameter mismatch between control and actual machine parameters. Experimental results validates better and more stable induction motor drive performance comparing to the case when conventional current reconstruction method is used.

EEI1.6
AN EXPERIMENTAL APPROACH TO THE EVALUATION OF POWER LOSSES IN LAMINATED CORE

Dejan Reljić, Faculty of Technical Sciences, University of Novi Sad, SERBIA
Ivan Todorović Faculty of Technical Sciences, University of Novi Sad, SERBIA

Prediction of power losses in soft ferromagnetic laminations has been studied over many years. A variety of loss models with good prediction capability has been proposed in the literature. However, a procedure for identifying unknown models parameters relies on a set of experimental data. On the other hand, steel manufacturers usually do not provide enough measurement data. Therefore, it is necessary to perform the characterization of the magnetic material. In this paper, magnetic properties measurements of the laminated ring-shape core of grade M530-50A have been presented. A special focus has been put on power losses. The specific power losses in laminated ferromagnetic core have been obtained at a few different magnetization frequencies and sinusoidal time-varying magnetic flux density levels. The determined losses can later be used to adjust power loss models. Here, an interpolation method for power losses evaluation has been proposed. The performance of the method has been verified by experiment.

ELECTRIC CIRCUITS AND SYSTEMS AND SIGNAL PROCESSING – EKI

EK1. Analog and Digital Electronic Circuits
Chairman: Budimir Lutovac, University of Montenegro,
Faculty of Electrical Engineering, Podgorica
Tuesday, June 08, 2015, 8:30-10:30, Room 1A

EKI1.1
Invited paper
SYSTEMS FOR ANALOG AND MIXED SIGNAL
PROCESSING IN INTEGRATED TECHNOLOGY

Dražen Jurišić, Faculty of Electrical Engineering and
Computing, University of Zagreb, Unska 3, 10000 Zagreb,
CROATIA

Despite the overwhelming trend of digitization of
electronic systems, and many indisputable advantages of
having digital signal processing compared to analog,
hardware towards the real, outside world, is a part of the
overall mixed system and remains mostly analog. This
analog part, in most IC-system chips is well known as
"analog-front-end" (AFE). Therefore, the analog
electronic circuits as part of an AFE, not only will remain
an important part of most integrated systems, but often
represent one of the bottlenecks in achieving low power
consumption and small area on an integrated circuit. This
explains why the development and design of new and
improved (from the standpoint of IC design) analog
electrical circuits still plays an important role - and will
likely continue to play an important role – in the
development of new and advanced systems-on-chip.One
of the types of analog circuits that have traditionally
lagged behind the others in the process of designing in
integrated-circuit form is frequency-selective filters.
Filters on the chip, may not have inductances; in the time-
continued domain they are the so-called 'active RC
filters', which means they combine resistors and
capacitors with voltage or current amplifiers. Reasons for
the delay in the design of integrated active-RC filters are
manifold, but one of the most important are theirs large
components tolerances (as a consequence there is a need
for circuit tuning), voltage noise within the circuit, limited
dynamic range and the size of the chip. The new and
innovative ideas arise in the design of time-continuous
filters from the application of network and transmission
line theory. Some special situations in communication
systems require novel topologies in filter design, and
solve different problems that are important in modern
analog IC design. The new approaches are: (i) savings in
chip area in elliptical filters in the integrated design using
signal-flow graphs, (ii) reducing the sensitivity to
variations in the component values by application of
negative feedback, (iii) filter partitioning for efficient on-
chip filter tuning, and (iv) the new structure of the active-
RC filter that is used to build ADSL splitter; a stability
problem to be solved with different telephone-line
terminations in different countries. All four systems are
suitable to be designed in the analog filter IC design.

EKI1.2
TEACHING CONTEMPORARY ELECTRONICS USING
WOLFRAM LANGUAGE

Miroslav Lutovac, Singidunum University, Danijelova 32,
11000 Belgrade, SERBIA
Vladimir Mladenović, Faculty of Technical Sciences, Čačak,
University of Kragujevac, SERBIA

Paper presents a new concept of teaching analog and
digital electronics courses to electrical engineering
students which uses a computer algebra system (Wolfram
language) and numeric solvers. Wolfram language is used
to formulate circuit equations and prepare for symbolic
solving. Exercises introduce basic semiconductor
elements and their use in real-world circuits. This
approach provides to design and optimize electronic
circuits. Students are free from manual solving large
system of equations and are focused on understanding the
functional model and simulation of complex electrical
systems with complex devices.

EKI1.3
EFFICIENT REALIZATION OF FARROW STRUCTURE
FOR SAMPLING RATE CHANGE ON FPGA PLATFORM

Bogdan Marković, Bitgear Wireless Design Services d.o.o.,
Stevana Markovića 8, Zemun, Belgrade, SERBIA
Jelena Ćertić, Univerzitet u Beogradu, Elektrotehnički
fakultet, Bulevar Kralja Aleksandra 73, Belgrade, SERBIA

In numerous implementations of software defined radio
(SDR) there is a need for sampling rate change of the
system input signal. When the relation between signal
interpolation and decimation is shown as a fraction of two
large integer numbers, Lagrange interpolation based on
Farrow structure can be used for the efficient filter
realization. This paper highlights efficient realization and
estimation of necessary resources for polynomial cubic
Lagrange interpolation in the case of the demand for the
signal sampling rate change with the factor 160/147 on
Field-Programmable Gate Array architecture (FPGA).

EKI1.4
EMULATION OF A MEMRISTOR ELEMENT USING A
PROGRAMMABLE MICROCONTROLLER DEVICE

Milutin Nešić, School of Electrical and Computer
Engineering of Applied Studies Belgrade, 283 Vojvode Stepe,
Belgrade, SERBIA
Stefan Ivanović, School of Electrical and Computer
Engineering of Applied Studies Belgrade, Belgrade, SERBIA
Amela Zeković, School of Electrical and Computer
Engineering of Applied Studies Belgrade, 283 Belgrade,
SERBIA
Slavica Marinković, School of Electrical and Computer
Engineering of Applied Studies Belgrade, 283 Belgrade,

SERBIA
Bratislav P. Marinković, Institute of Physics, University of Belgrade, Pregrevica 118, Pregrevica, SERBIA
Borislav Hadžibabić, School of Electrical and Computer Engineering of Applied Studies Belgrade, Belgrade, SERBIA

This paper deals with emulation of a memristor, a device that recently has attracted a considerable interest since its fabrication based on transition metal oxides (TiO2-x/TiO2) as resistance changing materials. The model and the circuit that emulates the behavior of the forth basic element (memristor) is based on the programmable microcontroller device that exploits the pulse width modulation (PWM) to create the response function that is characteristic of this element (the connection between magnetic flux and electric charge at every instance of time). Device has been realized and tested following the fingerprints that characterize the memristor behavior (changing resistance with memory effect, pinched hysteresis loops). The applications of the memristors have been already broad, starting from new types of non-volatile memories till neuromorfic devices.

EKI1.5
POWER MANAGEMENT FOR WIRELESS SENSOR NODES

Strahinja Janković, School of Electrical Engineering,University of Belgrade, Bul. kralja Aleksandra 73, Belgrade, SERBIA
Ivan Popović, School of Electrical Engineering,University of Belgrade, Belgrade, SERBIA
Aleksandra Lekić, School of Electrical Engineering,University of Belgrade, Belgrade, SERBIA
Lazar Saranovac, School of Electrical Engineering,University of Belgrade, Belgrade, SERBIA

Power management of battery powered devices is becoming more important. In this paper layer for Multimode Wireless Communication (MMWC) is presented, which allows significant power savings by turning off the wireless interface in time intervals when it is known that there will be no communication with the central node. Three different modes are supported, based on the amount of data that needs to be transmitted and data acquisition rate. MMWC layer has been implemented and tested on CC430 based development board and it is shown that power savings up to 95% can be achieved in certain modes.

EKI1.6
ONE EXERCISE FOR A VIRTUAL LABORATORY IN THE FIELD OF SIGNAL SAMPLING

Josif Tomić, Faculty of Technical Sciences, University of Novi Sad, Trg Dositeja Obradovica 6, Novi Sad, SERBIA
Trajan Stalevski, Public company Nuclear Facilities of Serbia, Mike Petrovica Alasa 12-14, Belgrade, SERBIA
Vladimir Katić, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Miloš Živanov, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA

The latest developments in the technology of virtual instruments, remote metering, distributed systems, and interactive learning environments have greatly changed the traditional approach to teaching and practical experimentation at any level of education, from technical secondary schools, basic academic courses, to continual education in the industry. This paper presents the realization of one exercise in the field of digital signal processing (DSP), which is implemented in a virtual laboratory. In this example, a discrete signal is generated by the sampling of a sinusoidal signal. When the normalized f/fs frequency of the discrete signal becomes greater than 0.5, or the Nyquist frequency, the aliasing effect becomes evident. The remote laboratory is developed in the LabVIEW software package and the measurement data are sent over the Internet via CGI protocol. The system consists of a server with measurement application and one or more clients which have independent access to the measurement data.

EKI1.7
NONCOHERENT FSK/ASK SIGNAL DETECTION WITH TWO SYMBOLS CORRELATED NOISE

Vladimir Mladenović, Faculty of Technical Sciences, Čačak, University of Kragujevac, SERBIA
Miroslav Lutovac, Singidunum University, Danijelova 32, 11000 Belgrade, SERBIA

In this paper, performances of digital telecommunication noncoherent FSK/ASK system are analyzed when noise is present. This system is composed of filters and phase detectors. System transmits two symbols. The noise is correlated. In case when noise is not correlated, the probability error is obtained very simply in one moment. But, in case when noise is correlated, it is important to obtain probability error of codeword from two and more symbols.

EKI2. Signal Processing Applications
Chairman: Irini Reljin, School of Electrical Engineering, Belgrade, Serbia
Tuesday, June 09, 2015, 15:00-16:15, Room 1A

EKI2.1
MULTIFRACTAL ANALYSIS OF STATISTICALLY MULTIPLEXED MULTIVIEW 3D VIDEOS BY THE HISTOGRAM METHOD

Amela Zeković, School of Electrical and Computer Engineering of Applied Studies Belgrade, 283 Vojvode Stepe, Belgrade, SERBIA
Irini Reljin, University of Belgrade, School of Electrical Engineering, Bulevar kralja Aleksandra 73, Belgrade, SERBIA

In this paper, an analysis of multiplexed multiview 3Dvideo is presented. Streams of 3D videos are created from video frames in statistically multiplexed fashion using frames from videos with different video quality.

Variability and burstiness of the streams are analyzed. Calculation of multifractal properties is performed by the histogram method. For the analysis, publicly available long frame size traces are used.

EKI2.2
APPLICATION OF MULTIFRACTAL MODEL FOR IMAGE DENOISING

Milorad Paskaš, University of Belgrade, Innovation Center of School of Electrical Engineering, Bulevar kralja Aleksandra 73, Belgrade, SERBIA
Marijeta Slavković-Ilić, University of Belgrade, Innovation Center of School of Electrical Engineering, Bulevar kralja Aleksandra 73, Belgrade, SERBIA
Irini Reljin, University of Belgrade, School of Electrical Engineering, Belgrade, SERBIA

Some multifractal measures applied on 2D signals enables detection of edges. Combination of lowpassing filter, that eliminates noise, and mask, obtained using multifractal measures, provides effective denoising of images while preserving edges. Results obtained using quantitative mesures are promising.

EKI2.3
FACE RECOGNITION USING GABOR FILTERS AND $(2D)^2$PCA

Marijeta Slavković-Ilić, University of Belgrade, Innovation Center of School of Electrical Engineering, Bulevar kralja Aleksandra 73, Belgrade, SERBIA
Milorad Paskaš, University of Belgrade, Innovation Center of School of Electrical Engineering, Bulevar kralja Aleksandra 73, Belgrade, SERBIA
Branimir Reljin, University of Belgrade, School of Electrical Engineering, Belgrade, SERBIA
Dubravka Jevtić, University of Belgrade, School of Electrical Engineering, Belgrade, SERBIA

A method for human face recognition, based on two-directional two-dimensional principal component analysis, $(2D)^2$PCA, and Gabor wavelet representation, is proposed. Gabor filter bank with 5 scales and 8 orientations is used for face representation. The $(2D)^2$PCA is applied directly on the Gabor transformed matrices. The ORL database of faces is used for testing and evaluation of proposed method.

EKI2.4
GRAPHICAL USER INTERFACE FOR HEARTBEAT ANALYSIS

Milan Milivojević, University of Belgrade, School of Electrical Engineering, Bulevar kralja Aleksandra 73, Belgrade, SERBIA
Ana Gavrovska, University of Belgrade, School of Electrical Engineering, Belgrade, SERBIA
Branimir Reljin, University of Belgrade, School of Electrical Engineering, Belgrade, SERBIA

During the past few decades heart rate variability (HRV) has been established as an important tool alongside other cardio related physiological signals. In this paper, a new graphical user interface for heart beat analysis is presented. The interface is developed in order to deal with new trends for health state monitoring such as seismocardiograms.

EKI2.5
SINGULARITY SPECTRUM ANALYSIS OF DIFFERENT CAMERA MODELS

Ana Gavrovska, University of Belgrade, School of Electrical Engineering, Bulevar kralja Aleksandra 73, Belgrade, SERBIA
Milan Milivojević, University of Belgrade, School of Electrical Engineering, Belgrade, SERBIA
Irini Reljin, University of Belgrade, School of Electrical Engineering, Belgrade, SERBIA

In modern information age the origin of images is often unknown. Due to this fact, identification of equipment for acquisition is a challenge and valuable in several research areas, such as: image and video analysis, forgery detection, video signal forensics, etc. In this paper, we perform singularity spectrum analysis for images taken with several different camera models.

ELECTRONICS – ELI

ELI1.1

RELIABILITY OF WIRELESS SENSOR NETWORKS IN PRECISION AGRICULTURE

Mare Srbinovska, Faculty of Electrical Engineering and Information Technologies in Skopje, Ss. Cyril and Methodius University, Skopje, MACEDONIA
Cvetan Gavrovski, Faculty of Electrical Engineering and Information Technologies in Skopje, Ss. Cyril and Methodius University, Skopje, MACEDONIA
Vladimir Dimcev, Faculty of Electrical Engineering and Information Technologies in Skopje, Ss. Cyril and Methodius University, Skopje, MACEDONIA
Zivko Kokolanski, Faculty of Electrical Engineering and Information Technologies in Skopje, Ss. Cyril and Methodius University, Skopje, MACEDONIA
Dimitar Dimitrov, Faculty of Electrical Engineering and Information Technologies in Skopje, Ss. Cyril and Methodius University, Skopje, MACEDONIA

Reliability is one of the most important performance measures and high level of reliability is a significant requirement for a wireless sensor networks. Reliability modeling and analysis are key steps to the design and optimization of sensor network systems. Wireless sensor network (WSN) technologies are the major driver of the development of precision agriculture. In design and development of Wireless Sensor Networks (WSNs), one of the main challenges is to achieve long lasting battery lifetime. The aim is to develop a robust, low maintenance and low cost wireless sensor network system which would be used for optimization of greenhouse crop production. This paper proposes a model for evaluating the reliability of WSNs considering the battery level as a key factor. Also the paper analyzes reliability enhancement by existing fault tolerant methods in WSN and compares the performance of these techniques with the technique we developed.

ELI1.2

GRAPHIC REPRESENTATION OF THE SYNTHESIS RESULTS IN A TELECOMMUNICATION-FILTER DESIGN SUITE

Ivan V. Litovski, Accenture, London, UK
Vančo B. Litovski, Faculty of Electronic Engineering, University of Niš, SERBIA

In the telecommunication-filter design suit an important activity is to visualize the analog prototype transfer function (TF) synthesis results. That allows the designer

to verify its design and to generate documents related to the pproper phase of the design process. In this paper part of the RM software will be described that performs generation of frequency and time domain responses given the TF of a filter. Programs for amplitude, attenuation, phase, and group delay responses will be described for the frequency domain encompassing low-pass, band-pass, band-reject, high-pass and all-pass filters. Programs for drawing the time domain responses including Dirac and Heaviside excitations will be described for low-pass filters only. A main program enabling repetitive use of the TF analysis data for generation different drawn characteristics will be described too.

ELI1.3

ON THE SYNTHESIS AND REALIZATION OF SELECTIVE LINEAR PHASE IIR FILTERS

Dejan Mirković, Faculty of Electronic Engineering, University of Niš, SERBIA
Ivan V. Litovski, Accenture, London, UK
Vančo B. Litovski, Faculty of Electronic Engineering, University of Niš, SERBIA

This paper gives an overview of the procedure of design of selective linear-phase IIR digital filters. Synthesis of minimum-phase transfer functions will be described. Two approximation criteria will be implemented for constant group delay approximation: the maximally flat and the equi-ripple. The synthesis in the s-domain will be performed in two steps. First, a polynomial function exhibiting linear phase will be synthesized and then transmission zeros located on the imaginary will be added. The IIR filter will be obtained by bilinear transform. To avoid stability problems and, in the same time, problems related to the signal dynamics within the filter, parallel implementation of the IIR filter will be used. Two examples will be given exemplifying the implementation of the two approximation criteria used.

ELI1.4

LOW POWER 65 NM CMOS LNA FOR 77 GHZ AUTOMOTIVE RADAR

Ivan Jevtić, School of electrical engineering, University of Belgrade, SERBIA
Radivoje Durić, School of electrical engineering, University of Belgrade, SERBIA

This paper presents a low power 77 GHz low noise amplifier (LNA) implemented in 65 nm CMOS RF process for automotive radar. LNA was designed using gm=ID methodology, based on transistors inversion factor. This methodology allows very precise estimation of transistor's parameters which are used in the overall design procedure. LNA consists of 3 cascode stages connected in cascade. This LNA achieves an average

power gain of 15 dB at 77 GHz and average noise figure of 6.3 dB. Input return loss is better than -15 dB at 77 GHz. The LNA consumes only 10.66mW from a 1.2 V supply voltage. LNA was designed in TSMC 65 nm technology using Cadence Virtuoso EDA.

ELI1.5
ADJUSTABLE LOW-POWER NON-OVERLAP CLOCK GENERATOR FOR SWITCHED-CAPACITOR CIRCUITS

Melikyan Vazgen Sh., Department of Microelectronics Circuits and Systems State Engineering University of Armenia; Synopsys Armenia CJSC, ARMENIA
Galstyan Vache A., Department of Microelectronics Circuits and Systems State Engineering University of Armenia; Synopsys Armenia CJSC, ARMENIA
Aleksanyan Ani L., Department of Microelectronics Circuits and Systems State Engineering University of Armenia; Synopsys Armenia CJSC, ARMENIA
Melikyan Nazeli V., Department of Microelectronics Circuits and Systems State Engineering University of Armenia; Synopsys Armenia CJSC, ARMENIA
Borisav Jovanović, Faculty of Electronic Engineering, University of Niš, SERBIA

This paper presents design of energy-efficient non-overlap clock generator (NOCG) based on three transistor XOR gate. Two control voltages provide adjustable non-overlap period and assure 50% duty cycle of two phase output signal. The proposed structure is simple and uses less MOS transistors than in conventional NAND based NOCGs. Due to structure of XOR gate and controllable signal-to-ground resistance, small dynamic power consumption was achieved while providing low sensitivity to supply voltage variations.

ELI1.6
LOW-POWER AND HIGH SPEED HIGH-TO-LOW LEVEL SHIFTER

Melikyan Vazgen Sh., Department of Microelectronics Circuits and Systems State Engineering University of Armenia; Synopsys Armenia CJSC, ARMENIA
Aleksanyan Ani L., Department of Microelectronics Circuits and Systems State Engineering University of Armenia; Synopsys Armenia CJSC, ARMENIA
Galstyan Vache A., Department of Microelectronics Circuits and Systems State Engineering University of Armenia; Synopsys Armenia CJSC, ARMENIA
Manukyan Sergey H., Department of Microelectronics Circuits and Systems State Engineering University of Armenia; Synopsys Armenia CJSC, ARMENIA
Harutyunyan Ani S., Department of Microelectronics Circuits and Systems State Engineering University of Armenia; Synopsys Armenia CJSC, ARMENIA
Sandra Ilijin, HDL Design House, Belgrade, SERBIA

A novel structure of high speed high-to-low level shifter is proposed. Due to decrease in the count of input thick-oxide transistors, the maximal output frequency is increased while providing 13.5% less power consumption than conventional designs. Usage of dual thick-oxide NMOS input cascade, lower output signal jitter is

obtained while providing near 50% duty-cycle. The circuit is designed with CMOS 40nm technology and simulated with SPICE.

ELI2. Electronics and power supplies
Chair: Miroslav Lazić, IRITEL d.o.o. Belgrade, Serbia
Thursday, June 11, 2015, 10:30-11:15, Kamin Room

ELI2.1
CHARACTERIZATION OF TELECOMMUNICATION AND IT DEVICES AS NONLINEAR LOADS

Marko A. Dimitrijević, Faculty of Electronic Engineering, University of Niš, SERBIA
Vančo B. Litovski, Faculty of Electronic Engineering, University of Niš, SERBIA

Power supply of telecommunication and IT devices are considered from the point of view of their power quality parameters. Quality indicators are defined intended to study the nonlinear nature of this kind of loads. These are based at the most advanced modern research in the field of nonlinear loads to the grid. A measurement setup is described being powerful, versatile but inexpensive and enabling both verification of compliance with existing standard and categorization within a series production. The measurement and data processing system was here implemented for characterization of power supplies and battery chargers of personal communication and IT devices which in fact are considered small loads. The goal of this choice was to expose the properties of this kind of loads and to give a picture of how "green" they are. A set of measurements was performed and measured data analyzed to show that no matter how small, this kind of loads are a burden to the quality of the power delivered to the customers and even to the functionality of the electrical grid as such.

ELI2.2
ONE MONTH AHEAD PREDICTION OF SUBURBAN AVERAGE ELECTRICITY LOAD

Jelena Milojković, Innovation Centre of Advanced Technologies ICNT, Niš, SERBIA
Vančo B. Litovski, Faculty of Electronic Engineering, University of Niš, SERBIA

One month ahead prediction os suburban average electricity load, based on short time series, is presented. It will be shown here first that for the subject of short term prediction of electricity load, even though a large a-mount of data may be available, only the most recent of it may be of importance. That gives rise to prediction based on limited amount of data. We here propose implementation of some instances of architectures of artificial neural networks as potential systematic solution of that problem as opposed to heuristics that are in use. To further rise the dependability of the predicted data averaging of two independent predictions is proposed. A specific approach to the choice of the number of hidden neurons will be

implemented. Example will be given related to monthly forecasting of the electricity load at suburban level. Prediction is carried out on real data taken the literature. Prediction errors lower than two percent were obtained.

ELI2.3
HYBRID SWITCH MODE DC/DC CONVERTERS

Miroslav Lazić, Dragana Petrović, Zoran Cvejić, Milan Pajnić, Iritel a.d. Belgrade, SERBIA
Dragana Petrović, Iritel a.d. Belgrade, SERBIA
Zoran Cvejić, Iritel a.d. Belgrade, SERBIA
Milan Pajnić, Iritel a.d. Belgrade, SERBIA

Hybrid switching DC / DC converters are converters that use the continuous and discrete change of dytu cycle. They are suitable for solving the problem of parall work of various alternative sources. And allow parallel operation of various alternative energy sources with electricity from fossil fuel. Paper describes a solution for hybrid DC / DC converter with special emphasis on the dynamic characteristics. Hybrid DC / DC converter in the feedback loop has two reference voltages. Described DC / DC converter is controllable as a digital converter, and a control output value as a converter with infinitely variable dytu cycle factor.

BIOMEDICINE – MEI

MEI1. Biomedical Techniques
Chairman: Dejan B. Popović, School of Electrical
Engineering, University of Belgrade, Serbia
Monday, June 8, 2015, 11:00-11:45, room 1B

MEI1.1
EFFECTS OF ELECTRODE ARRAY SHIFT ON SEMG-
BASED GRASP CLASSIFICATION

Milica S. Isaković, School of Electrical Engineering,
University of Belgrade, SERBIA and Tecnalia Serbia Ltd.,
Belgrade, SERBIA
Nadica Miljković, School of Electrical Engineering,
University of Belgrade, SERBIA and Tecnalia Serbia Ltd.,
Belgrade, SERBIA
Matija Štrbac, School of Electrical Engineering, University
of Belgrade, SERBIA and Tecnalia Serbia Ltd., Belgrade,
SERBIA
Mirjana B. Popović, School of Electrical Engineering,
University of Belgrade, SERBIA

The aim of this study is to evaluate the effects of
electrode shift in multisession recording on sEMG-based
classification of grasping movements. sEMG data were
recorded during three different grasping movements for
two slightly different electrode array positions in two
sessions. Principal Component Analysis was used for
feature extraction, and the simple piecewise quadratic
classifier was applied. The classification accuracy from
three healthy subjects suggests that the proposed analysis
can overcome both the effects of electrode array shift in
proximal direction and the multisession recording of
sEMG signals.

MEI1.2
AN INFORMATION AND RELIABILITY ANALYSIS OF
HANDWRITING KINEMATICS

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The aim of this study was to develop the methodology for
handwriting analysis of different hand movement
disorders. Handwritings with cordless pen on the
digitizing tablet from 17 healthy young subjects were
recorded in four different conditions: dominant and non
dominant hand, with non immobilized and immobilized
wrist. These conditions were selected in order to simulate
frequent hand movement disorder. Variability of
handwriting kinematics, as well as related statistical
parameters was analyzed. Results of writing the two
words in Serbian Latin alphabet (Tia Šolaj) suggest that
writers have consistent handwriting and that handwritings
from different writers are dissimilar. Out of ten analyzed
descriptive statistical parameters, the four following:
coefficients of variation, 1th percentile, maximal and
minimal values of all calculated parameters are the first
candidates to be excluded from the further detailed
analysis of handwriting.

MEI1.3
TEXT MESSAGING FOR VISUALLY IMPAIRED

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Lana Popović-Maneski, Institute of Technical Sciences of the
Serbian Academy of Sciences and Art, Belgrade, SERBIA
This project is designed to help the visually impaired become
a part of modern forms of communication. In this paper, we
will present a hands-free device that is meant to be wirelessly
connected to a smartphone through an accompanying app
which will provide access to all forms of messengers and
enable the user to send, listen, respond to a text message, etc.
These many options have been made possible by combining
the movement of different fingers, without the need of any
kind of buttons or keyboards. The system is based on
accelerometers and Morse code. It's easy to use, discreet and
it also provides privacy, opposed to the voice input. So far,
we have made a non-wireless device and programmed and
tested it in LabView and Matlab.

MEI1.4
A SOFTWARE TOOL FOR TUMOR DETECTION IN
WHOLE BODY PET SCANS

Nataša Petrović, University of Belgrade – Faculty of
Electrical Engineering
Milica M. Janković, University of Belgrade – Faculty of
Electrical Engineering
Mila V. Todorović-Tirnanić, Center for Nuclear Medicine,
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Positron Emission Tomography (PET) and Computed
Tomography (CT) imaging are essential diagnostic
techniques used in oncology. Manual tumor detection in
PET scans is time consumed. Commercial software do not
support the comparison of standard uptake index (SUV)
values of the same region of interest (ROI) in successive
reviews of the same patient. An algorithm for automated
tumor localization would significantly reduce the analysis
time and storing of results would facilitate monitoring of
tumor changes in successive PET examinations. The aim
of this paper is to develop a software tool for detection of
tumors in PET scans, so called "hot spots", based on
Tresholding and Seeded Region Growing methods. PET
scans are processed by commercial software Syngo MI

Application (Siemens, Germany) and by custom made software developed in .NET framework using C# programming language. Algorithm contains the following steps: 1) application of Tresholding method on PET scans, 2) automated detection of suspicious ROIs using Seeded Region Growing method, 3) calculation of maximal SUV for detected ROIs. All results of algorithm are achieved. Further, our tool provides visualization of whole body 3D model based on Maximum Intensity Projection technique. The comparison of the results of the algorithm and the results obtained by an experienced specialist in nuclear medicine is presented in the group of four patients.

MEI1.5

VALIDATION OF THE ACQUISITION SYSTEM SMARTING® FOR EMG RECORDINGS WITH ARRAY ELECTRODES

Ivan Topalović, PhD student with the School of Electrical Engineering, University of Belgrade
Milica Janković, School of Electrical Engineering, University of Belgrade
Dejan B. Popović, School of Electrical Engineering, University of Belgrade

The estimate of the muscle recruitment and force is most often based on the recordings of the electrical activity (EMG). Recent research results suggest that the use of array electrode provides much more accurate image of the muscle activity compared to the conventional signal acquired by two electrodes. We validated the electrophysiological digital acquisition system Smarting® which can acquire up to 24 signals at maximum of 500 samples per second and send them to a Windows or Android platform wirelessly via Bluetooth. We also tested the use of a custom designed array electrode for the detailed mapping of muscle activities. The validation was based on the estimated correlation of the timing (onset and offset), signal amplitude envelopes and power spectrum densities for the signals acquired with the Smarting® and with the commercial bioamplifier BioVision® connected to the National Instruments A/D card. The correlations were: 0.99 ± 0.01, 0.94 ± 0.03, 0.85 ± 0.09, thereby, we confirmed our hypothesis that the Smarting® is a very convenient and sufficiently accurate system for wireless EMG recordings from surface array-electrodes. The lower correlation of power spectral densities is the result of the design of the Smarting that is primarily designed for EEG signals; therefore has a lower gain at higher frequencies.

METROLOGY – MLI

MLI1.1
Invited Talk
MULTIPLE-RESONATOR-BASED HARMONIC
ANALYSIS

Miodrag Kušljević, Termoelektro ENEL, Belgrade, SERBIA

A resonator-based observer is a recursive algorithm which can be used for the calculation of the harmonic components of periodic signals. One of the advantages of the recursive spectrum estimation algorithms is that they have better tracking properties than block-based methods (e.g., DFT: Discrete Fourier Transform). This is particularly important when the spectrum estimation is used in real-time systems. In addition to that, the frequency of the signal does not need to be on the DFT grid. By introducing multiple-resonators, i.e. cascades of identical resonators in parallel, the classical frequency sampling method based on the direct utilization of the Lagrange interpolation technique, corresponding to the single-resonator-based structure, is extended to a rather efficient Hermite interpolation scheme. In addition, the output taps of the multiple resonators may fix not only the complex harmonic values but also, according to the actual resonator multiplicity, their first, second, third, fourth, and so on, derivatives at the corresponding frequency. In order to adapt the achieved digital differentiators to their optimized frequency responses around the harmonic frequencies, it is possible to reshape the filters transfer functions. The estimation technique is suitable for application in a wide range of frequency changes, transient conditions, and interharmonic presence, with benefits in a reduced complexity and computational effort. To demonstrate the performance of the developed algorithm, computer simulated data records are processed.

MLI 1.2
Invited Talk
LOW-COST AND MINIATURE PASSIVE SENSOR
INTERFACING BASED ON MICROCONTROLLERS

*Živko Kokolanski, Faculty of Electrical Engineering and
Information Technologies, Ss. Cyril and Methodius
University in Skopje, Scopje, MACEDONIA*

Almost every microcontroller-based measurement system contains a sensor. When using passive sensors, the overall performance of the system greatly depends on the applied sensor interface. There are a lot of known passive sensor interfaces for microcontrollers with different properties in terms of cost, size and performance. Depending on the application, some interface properties take precedence over the others. When it comes to cost and size, the direct sensor-to-microcontroller interface approach is advantageous. This sensor interface uses time-to-digital (TD) conversion to estimate the sensor measurand without analog to digital (AD) converter. The application of the sensor interface covers all types of passive sensors (resistive, capacitive and inductive), all sensor configurations (single-ended, differential and bridge), and yet includes calibration.

The aim of this talk is to address different aspects on direct sensor-to-microcontroller interface with focus on accuracy, speed, resolution, cost, and implementation in a microcontrollers. The talk will give insight to all important aspects of the optimization of the interface parameters to achieve best performance for a given application, and will be supported by practical implementation details, experimental results, and working prototype systems.

MLI1.3
A CONCEPT OF AN EXPERIMENTAL SOLUTION FOR
DIGITAL STOCHASTIC MEASUREMENT OF EOG
SIGNAL

*Jelena Đorđević-Kozarov, Faculty of Electronic Engineering,
University of Niš, Niš, SERBIA*
*Platon Sovilj, Faculty of Technical Sciences, University of
Novi Sad, Novi Sad, SERBIA*
*Dejan Mitić, Faculty of Electronic Engineering, University of
Niš, Niš, SERBIA*
*Vladimir Vujičić, Institute of Technical Sciences of Serbian
Academy of Sciences and Arts, Belgrade, SERBIA*
*Dragan Radenković, Faculty of Electronic Engineering,
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This paper describes the concept of an experimental hardware solution, which has been designed in order to verify the simulation model for digital stochastic measurement (DSM) of electrooculography (EOG) signal. Designed experimental hardware solution is based on a personal computer (PC) with additional microcontroller hardware for analogue signal processing. The experimental printed circuit board (PCB) has been designed with microcontroller (MCU) STM32F303C6T6.

MLI1.4
A SOLID-STATE CURRENT LIMITING DEVICE

*Jovan Mitrović, Faculty of Technical Sciences, University of
Novi Sad, Novi Sad, SERBIA*
*Nemanja Gazivoda, Faculty of Technical Sciences,
University of Novi Sad, Novi Sad, SERBIA*
*Željko Beljić, Faculty of Technical Sciences, University of
Novi Sad, Novi Sad, SERBIA*
*Božidar Vujičić, Faculty of Sciences, University of Novi Sad,
Novi Sad, SERBIA*
*Zoran Mitrović, Faculty of Technical Sciences, University of
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A new class of positive temperature coefficient resistors, PPTC (polymeric positive temperature coefficient) with voltage range that includes power grid voltages are implemented in current (power) limiting devices for grid powered devices. The power company, as a socially responsible firm, can provide limited power to customers that have low income using such devices. The current limiting devices can be used as an alternative to a complete switching off the grid for customers that do not pay their bills. Further, more complex applications are expected.

MLI1.5
THEORY OF DIGITAL STOCHASTIC MEASUREMENT OF DEFINITE INTEGRAL PRODUCT OF TWO OR MORE SIGNALS USING TWO-BIT AD CONVERTERS

Boris Ličina, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Platon Sovilj, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Dragan Pejić, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Bojan Vujičić, Faculty of Sciences, University of Novi Sad, Novi Sad, SERBIA
Marjan Urekar, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Vladimir Vujičić, Institute of Technical Sciences of Serbian Academy of Sciences and Arts, Belgrade, SERBIA

Digital stochastic measurement has clear advantages over standard measurement approach in three challenging areas: measurement of fast-changing signals, measurement of noisy signals, and measurement that requires high accuracy and linearity. This paper presents theory of digital stochastic measurement of the definite integral product of two or more signals using 2-bit AD converters. The developed theory is based on Central limit theorem. The mathematics presented in this paper may appear complex, especially because the time within the measurement interval is treated as an independent uniform random variable. Described measurement concepts enable not only designing the instruments with advanced metrological characteristics, but also rather simple design of these instruments.

MLI1.6
COMPARATIVE ANALYSIS OF ERROR DISTRIBUTION FOR SYMMETRIC HYSTERESIS LOOP CURVES APPROXIMATION BY MEANS OF COSINE AND TRIGONOMETRIC POLYNOMIAL

Nenad Petrović, School of Electrical Engineering, "Stari grad", Belgrade, SERBIA
Velibor Pjevalica, JP Srbijagas, Novi Sad, SERBIA
Nebojša Pjevalica, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Nikola Teslić, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA

The paper proposes a mathematical procedure for comparative error analysis for symmetrical hysteresis loop curve (SHLC) approximation by cosine (CP) and trigonometric (TP) polynomial. The general part of the procedure can be universally applied to all subsets of samples representing the Chebyshev nodes of the first (ChI) and the second (ChII) kind. The particular part of the procedure depends on the type of nodes and the fact whether the number of nodes for the half of a period is even or odd. Therefore, the second part of the procedure will be exposed for the case of an odd number of ChII nodes. The analysis will show that this is the case when the difference between the errors of approximation of SHLC by using CP and TP can be considered negligible.

MICROELECTRONICS AND OPTOELECTRONICS – MOI

MOI1. Optoelectronics
Chairman: Miloljub Smiljanić, Academy of Engineering
Sciences of Serbia, Belgrade, Serbia
Thursday, June 11, 2015, 8:30-9:15, room 1A

MOI1.1
POLYMER BASED PHOTODETECTOR WITH GAIN
ENABLED BY GOLD NANOPARTICLES INTERLAYER

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71272 USA and is now wit Sigma Engieers and Constructors,
Baton Rouge, LA70816, USA
Sandra R. Zivanovic, Member, IEEE, Electrical Engineering
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Substantial photoconductive gain at low bias voltages has
been realized for thin-film photodetectors that use poly(3-
hexylthiophene): phenyl-C61-butyric-acid-methyl-ester
(P3HT:PCBM) bulk heterostructure as an active layer.
The external quantum efficiencies as high as 1500% have
been observed when a gold nanoparticle layer was
introduced at the anode interface of the photodectors. The
gain response was highly dependent on the thickness of
the active layer of the photodetector with the best results
achieved with the thinnest P3HT:PCBM layer of 65nm.
The gain is the result of the injection of secondary
electrons due to hole charge trapping at the
semicontinuous gold layer.

MOI1.2
MEASUREMENT OF PHYSICAL CHARACTERISTICS
OF TRANSPARENT PARTICLES BY OPTICAL PHASE
RECOVERING

Zoran Djinović, Austrian Center for Medical Innovation and
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Wiener Neustadt, AUSTRIA
Miloš Tomić, School of Electrical Engineering, University of
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Marijana Stojković, Austrian Center for Medical Innovation
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Wiener Neustadt, AUSTRIA
Martin Miljojković, Austrian Center for Medical Innovation
and Technology, ACMIT Gmbh, Viktor Kaplan str. 2, 2700
Wiener Neustadt, AUSTRIA

In this paper we present a method for measurement of
diameter and index of refraction of small spherical
transparent particles in fluid suspension. The particle
optical path diameter is computed from optical phase
change profile measured by low-coherence
interferometric technique. The physical particle diameter
is obtained from measured time of travel of the particle
through the inspection beam. The particle average
refraction index is determined from these two diameters.

We experimentally tested the method using an optofluidic
platform based of Mach-Zehnder interferometric
configuration. We measured characteristics of glass balls
and cylinders of 50-230 μm in diameter, which has been
introduced into the inspection microchannel using water
suspension laminar flow. We found the measurement
uncertainty of optical diameter of several micrometers,
predominantly affected by vertical position of particle in
the microchannel and velocity steadiness of laminar flow.

MOI1.3
TWO DIFFERENT COHERENCE LENGTH SOURCES
USED IN FIBER-OPTIC SENSOR OF WING
DEFLECTION

Miloš Tomić, School of Electrical Engineering, University of
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Zoran Djinović, Austrian Center for Medical Innovation and
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Wiener Neustadt, AUSTRIA
Marijana Stojković, Austrian Center for Medical Innovation
and Technology, ACMIT Gmbh, Viktor Kaplan str. 2, 2700
Wiener Neustadt, AUSTRIA

In this paper we deal with a non-destructive sensing
technique aimed to the deflection detection of aircraft's
morphing wings. Fiber-optic coils adhesively bonded on
both faces of wing act as transducers. Small strain of
coils, caused by wing deflection generates a change of
phase of the light propagating through the optical fiber.
Detection of the phase is performed by an "all-in-fiber"
Michelson interferometer. We simultaneously use two
types of light source, with different coherence lengths and
different wavelengths. The long coherence length source
assures a wide measurement range of wing deflection; the
short coherence length source provides an absoluteness of
measurement. We present here a technique for zero
deflection point determination and results of phase
measurement obtained with coils bonded on a specimen
made as a sandwich of CFRP honeycomb structures.
Proportional uncertainty obtained in these experiments
was about 1% in measuring range of ±5º of deflection.

MOI2. MEMS
Chairman: Zoran Djinović, Austrian Center for Medical
Innovation and Technology, ACMIT Gmbh, Wiener
Neustadt, AUSTRIA
Thursday, June 11, 2015, 10:30-11:30, room 1A

MOI2.1
DESIGN AND FABRICATION OF THE SILICON
MOVING PLATE WITH CANTILEVER BEAMS FOR
PARAFFIN BASED ACTUATOR

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Viktor-Kaplan-Straße 2, AUSTRIA

In this work we present the design and manufacturing of
the silicon moving plate with cantilever beams. The
structure is of a monolithic type which comprises the
anchor part, the two cantilever beams and the moving
plate. The whole structure was manufactured by using
sofisticated compensation masks to prevent silicon
underetching and by using double side photolithography.
The set of the three photolithographic masks were used
and the etching was performed from both sides of the
silicon wafer simultaneously in 25 wt% TMAH water
solution. This structure was originaly developed for the
paraffin based actuator, but it could be used on various
platforms including the moving mirror applications, for
the steering purposes.

MOI2.2
STABILIZATION OF THE JET IN CONE-JET MODE IN
ELECTROSPRAYING FOR MICROFLUIDIC
APPLICATIONS

Saša Marjanović, Student Member, IEEE, University of Novi
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Vasa Radonić, Member, IEEE, University of Novi Sad, Dr.
Zorana Đinđića, 21000 Novi Sad, SERBIA
Jovan Matović, Member, IEEE, University of Novi Sad, Dr.
Zorana Đinđića, 21000 Novi Sad, SERBIA
Vesna Crnojević-Bengin, Member, IEEE, University of Novi
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Microfluidic technology suffers from various drawbacks
and limitations, such as channel clogging, process
variations, highly resistive flow in case of high viscosity
liquids, etc. We propose new techniques for manipulation
of liquids on micro scale, were fluids are observed and
analyzed in free space, rather than in microchannels,
based on the electrospray and Taylor cone theory.
Furthermore, we propose configurations that suppress the
instability of the Taylor cone and the jet produced in the
cone-jet mode.

MOI2.3
ANALYSIS OF REVERSIBLE ADSORPTION IN
CYLINDRICAL MICRO/NANOFLUIDIC CHANNELS
FOR ANALYTE SENSING AND SAMPLE DILUTION
APPLICATIONS

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Micro/nanochannels are used for transport of fluids
between different parts of microsystems, but can also be
the place where the main function of the microsystem is
performed (a chemical reaction, analyte detection etc.).
On the walls of a channel adsorption of particles that exist
in the fluid occurs, which may or may not be desirable.
For example, in sensing applications adsorption enables
detection of a target substance or elimination of a
competitor substance. Adsorption may also cause dilution
of the transported fluid, which is useful e.g. for sample
purification, but detrimental when the fluid has to be
delivered with unaltered chemical properties. Obviously,
the analysis of adsorption phenomena is necessary in

order to estimate and then optimize the micro/nanofluidic system performance. In this paper reversible adsorption in cylindrical micro/nanochannels is analyzed by using both the theoretical expressions and computer simulations. Applicability of the two-compartment model for approximation of the particles concentration distribution in a channel is considered, as it can significantly facilitate the analysis of the adsorption process on the channel walls.

MOI2.4
MODELLING THE MAGNETOPHORESIS AND GRAVITY SETTLING-BASED SIZE SEPARATION OF NdFeB MAGNETIC MICROPARTICLES

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Properties of sintered NdFeB magnets strongly depend on granulation and size distribution of constituent particles, which requires an efficient method for their separation into relatively narrow size fractions. We investigated two methods of magnetic particle separation from a mixture with different sizes using simulation by finite element method: magnetophoresis and gravity settling. In the case of magnetophoresis magnetic particles ranging in diameter from 1 to 10 micrometer were deflected from the direction of continuous laminar flow by a perpendicular magnetic field. Larger particles were deflected from the direction of laminar flow more than smaller particles. The applied flow rate and strength and gradient of the applied magnetic field were the key parameters in controling the deflection. The gravity settling model simulated spherical grains falling in heptane. The particles of various sizes were divided according to the time to reach the bottom. The model used an axially symmetric fluid-flow simulation in a moving coordinate system, coupled with

an ordinary differential equation for the force balance of the particle (gravity and drag force). The grain accelerated from standstill and rapidly reached its terminal velocity. This velocity was approximatelly proportional to the square of the particle diameter, which led to a clear separation of 5-10 micrometer particles from those with a diameter of 1 micrometer.

nanoETRAN
Chairman: Zoran Jakšić
Thursday, June 11, 2015, 12:30-13:30, room 1A

MOI3.1
ANALYSIS OF THE INFLUENCE OF EXTERNAL MAGNETIC FIELD ON TRANSITION MATRIX ELEMENTS IN QUANTUM WELL AND QUANTUM CASCADE LASER STRUCTURES

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Jelena Radovanović, School of Electrical Engineering, University of Belgrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, SERBIA
Vitomir Milanović, School of Electrical Engineering, University of Belgrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, SERBIA

We present a method for modeling of nonparabolicity effects (NPE) in quantum nanostructures by using second order perturbation theory. The method is applied to analysis of quantum well structure and active region of a mid-infrared quantum cascade laser (QCL). This model will allow us to examine the influence of magnetic field on dipole matrix element in QCL structures, which will provide a better insight to how NPE can affect the gain of QCL structures.

MOI3.2
ALUMINUM-BASED SPOOF PLASMON STRUCTURES

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Plasmonic structures ensure electromagnetic field localization and concentration to subwavelength volumes, thus enabling numerous practical applications. Nanostructuring can be used to obtain novel electromagnetic modes in such structures, an example being the designer plasmon structures where one utilizes ordered arrays of subwavelength holes to mimick the behavior of metals in different frequency ranges and obtain the designer (spoof) plasmons, waves with a resonant frequency tailorable by design in a wide range. In this paper we consider designer plasmon structures using aluminum for the negative permittivity part instead of the usual gold or silver. We investigate patterns with complex subwavelength aperture shapes which ensure richer modal behavior of the designer plasmon structures, including a possibility to tailor their frequency dispersion and to obtain tailorable deeply subwavelength electromagnetic field hotspots. The aluminum-based designer plasmon structures are considered ab initio, utilizing the finite element method simulation and analytically. We conclude that a new degree of design freedom is obtained when utilizing aluminum-based subwavelength aperture arrays. It is important at that to take into account the influence of native oxide of aluminum that appears in practical structures.

MOI3.3
MULTIPURPOSE EXTRAORDINARY OPTICAL TRANSMISSION APERTURE ARRAYS AS OPTICAL CONCENTRATORS FOR ENHANCEMENT OF MID AND LONG WAVELENGTH INFRARED DETECTORS

Marko Obradov, Centre of Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Njegoševa 12, 11000 Belgrade, SERBIA
Zoran Jakšić, Senior Member, IEEE, Centre of Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Njegoševa 12, 11000 Belgrade, SERBIA
Dragan Tanasković, Centre of Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Njegoševa 12, 11000 Belgrade, SERBIA

Extraordinary optical transmission arrays (EOT) represent an especially important class of plasmonic metamaterials due to a multitude of their applications. Acting as impendance-matching structures, EOTs can be used as an antireflective layers. Due to the inherent high sensitivity of their spectral properties in response to the material composition of the subwavelength apertures they have important place in bio-chemical sensing applications as refractometric sensors. EOTs can be also used in transformation optics as light concentrators. We analyze the optical response of our structures utilizing finite element simulation. We investigate tuning of spectral properties of perforated thin metallic films using designer plasmons for optimum operation in the infrared range, especially at medium and long infrared wavelengths. Spectral properties of our EOT structure are considered both in terms of far field response (effective medium approach) described by scattering parameters and in terms of near field enhancement and field redistribution. In this paper we aim to maximize the optical energy density in the infrared photodetector located beneath the EOT by overlapping the reflection minimum with the optimal near field distribution in infrared photodetectors. It is shown that a large increase of detector responsivity and specific detectivity can be obtained, while at the same time offering a tunability of the desired operational wavelength range. An advantage of the approach is that both ultrathin and standard-thickness photodetectors can be enhanced and that the EOT structure simultaneously serves as an antireflective layer, thus eliminating a need for the deposition of an additional layer at the top.

MOI3.4
ELECTRON-ELECTRON INTERACTION AND THE QUANTUM HALL EFFECT IN GRAPHENE

Predrag M. Krstajić, Centre of Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Njegoševa 12, 11000 Belgrade, SERBIA

We study the influence of electron-electron interaction on the longitudinal conductivity in the quantum Hall regime in graphene. As it is known, the quantum Hall effect in graphene is different than in conventional semiconductors such as Si and GaAs and it exhibits a half-integer nature. It was shown in the paper that electron-electron interaction is important and contributes to the longitudinal conductivity significantly. The conductivity increases with the doping, i.e. electron concentration.

MICROWAVE TECHNIQUE, TECHNOLOGIES AND SYSTEMS – MTI

MTI1. Passive Microwave Circuits
Chairs: Aleksandar Nešić, "IMTEL-komunikacije" a.d.,
Belgrade, Serbia
Bratislav Milovanović, University Singidunum, Belgrade,
Serbia
Vesna Crnojević Bengin, Faculty of Technical Sciences,
University of Novi Sad, Serbia
Tuesday, June 9, 2015, 15:00-17:00, Room 1C

MTI1.1
Invited paper
NEAR-ZERO METAMATERIALS AND THEIR
APPLICATION TO THE DESIGN OF MICROSTRIP
FILTERS (WITH A SHORT EXCURSION TO THE
ACOUSTICAL DOMAIN)

Vesna Crnojević Bengin, Faculty of Technical Sciences,
University of Novi Sad, SERBIA

Metamaterial theory and techniques have passed almost 15 years of evolution. One of the established outcomes of this development are so called Near-Zero (NZ) metamaterials which exhibit a new physical effect of achieving zero value of propagation coefficient at non-zero frequencies. The talk will provide insights into various types of NZ metamatreials and show that microwave filters based on this new physical effect can have resonators much shorter than the guided wavelength, thus paving the way for micro-miniaturization of filters. A combined approach to filter design will be presented which uses both the conventional filter design technique as well as the metamaterial approach to filter design. It will be shown how NZ propagation can be obtained in quasi-TEM Circuits and some concrete NZ microstrip filters will be presented. Finally, the concept will be extended beyond electromagnetic waves and into the acoustical domain where NZ propagation yields some very interesting phenomena.

MTI1.2
DESIGN OF PRINTED ANTENNA ARRAY WITH FLAT-
TOP SHAPED-BEAM PATTERN

Marija Milijić, Faculty of Electronic Engineering, University
of Nis, SERBIA
Aleksandar Nešić, "IMTEL-komunikacije" a.d., Belgrade,
SERBIA
Bratislav Milovanović, University Singidunum, Belgrade,
SERBIA

The proposed printed antenna has the flat-top beam pattern with 36° flat gain region. It consists of ten pentagonal elements array, feeding network, balun and corner reflector. The desired radiation pattern is achieved using appropriate phase and amplitude distributions for radiating elements. The required distributions, synthesized by genetic algorithm, are enabled by feeding network with impedance transformers. Both antenna array and feeding network are symmetrical microstrip structures eliminating parasitic radiation. The corner reflector of 60° angle is used to control antenna gain whose simulated values is more than 15 dBi at center frequency. Simulated side lobe suppression is more than 18 dB at center frequency while simulated VSWR is less than 2 in frequency range which is more than 54% of center frequency.

MTI1.3
MODELLING OF A CIRCULAR PATCH ANTENNA
WITH AN AIR GAP USING THE TLM METHOD

Jugoslav Joković, Faculty of Electronic Engineering,
University of Niš, SERBIA
Tijana Dimitrijević, Faculty of Electronic Engineering,
University of Niš, SERBIA

The self-written solver based on the TLM method in a cylindrical grid with an implemented compact wire model has been shown to be a very useful tool for modelling of microwave structures of circular geometry containing wire elements. The subject of investigation in this paper is a circular patch antenna with an air gap and a coaxial feed as an excitation, which shows several advantages over the classic configuration of the circular patch antenna. Simulated results are compared with results obtained by MATLAB code based on an approximate technique known as the cavity model.

MTI1.4
TWO-PORT WAVE DIGITAL NETWORK MODELS OF
IMPEDANCE INVERTERS

Biljana P. Stošić, Faculty of Electronic Engineering,
University of Niš, SERBIA
Nebojša S. Dončov, Faculty of Electronic Engineering,
University of Niš, SERBIA
Miloš Kostić, Faculty of Electronic Engineering, University
of Niš, SERBIA

In this paper, two-port equivalent wave digital network models of impedance inverters are synthesized, aiming to increase a number of types of microstrip structures that can be modeled by using wave digital filter theory. Wave digital networks of impedance inverters (K,±90°) are described in details and developed here based on scattering parameter formalism and two-port networks of parallel or series adaptors.

MTI1.5
COMPACT TLM MODEL OF DISPERSIVE
ANISOTROPIC CARBON-FIBRE MATERIAL

Miloš Kostić, *Faculty of Electronic Engineering, University of Niš, SERBIA*
Biljana P. Stošić, *Faculty of Electronic Engineering, University of Niš, SERBIA*
Nebojša S. Dončov, *Faculty of Electronic Engineering, University of Niš, SERBIA*
Bratislav Milovanović, *University Singidunum, Belgrade, SERBIA*

Compact model, based on Transmission Line Matrix (TLM) method with Z-transforms, is developed in order to efficiently describe thin carbon-fibre material panel. It uses digital filter (DF) to include the scattering coefficients of the panel without resorting to a fine mesh to describe the panel thickness. Anisotropic electric conductivity of carbon-fibre material is treated as frequency dependent parameter and its dispersive behaviour is implemented by employing the Drude model. Model accuracy and efficiency are verified through comparison with the fine TLM mesh results.

MTI1.6
GENERAL PLANAR TOPOLOGIES OF SINGLE-STAGE BAND PASS FILTERS WITH ANTIPARALLEL CONFIGURATION

Siniša Jovanović, *"IMTEL-komunikacije" a.d., Belgrade, SERBIA*
Bratislav Milovanović, *University Singidunum, Belgrade, SERBIA*

This paper explores a relation between electrical characteristics and topologies of single-stage band pass filters with antiparallel configuration. Corresponding general planar topologies are outlined for various filters' configurations from the basic version to extended versions for both unbalanced and balanced varieties. All the components of the filter prototype can be calculated using accurate approximate closed-form expressions depending on the desired electrical characteristics of the filter. The presented topologies are suitable for practical printed filter realization at a variety of substrates as well as planar circuits' fabrication technologies.

MTI1.7
TLM Z SIMULATION OF LEFT-HANDED METAMATERIALS BASED ON RETRIEVED EFFECTIVE PARAMETERS

Tatjana Asenov, *Innovation Centre of Advanced Technologies Ltd. Niš, SERBIA*
Miloš Kostić, *Faculty of Electronic Engineering, University of Niš, SERBIA*
Nebojša Dončov, *Faculty of Electronic Engineering, University of Niš, SERBIA*
Bratislav Milovanović - *University Singidunum, Belgrade, SERBIA*

In this paper a simulation based on TLM Z-transform method of a left-handed metamaterial (LH MTM) structure has been presented. The effective parameters of a LH MTM structure have been retrieved from its S-parameters and approximated using vector fitting. The

accuracy and stability of the approach have been verified by obtaining the close agreements between the analytic and simulated.

MTI2. Microwave Electronics
Chair: Olga Borić-Lubecke, University of Hawaii at Manoa, USA
Vera Marković, Faculty of Electronic Engineering, University of Niš, Serbia
Wednesday, June 10, 2015, 8:30-10:00, Room 1C

MTI2.1
Invited paper
WIRELESS TECHNOLOGY FOR PHYSIOLOGICAL MONITORING

Olga Borić-Lubecke, *University of Hawaii at Manoa, EE Department, 2540 Dole St, Honolulu, HI 96822, USA*
Victor Lubecke, *University of Hawaii at Manoa, EE Department, 2540 Dole St, Honolulu, HI 96822, USA*

Recent advances in wireless communications and sensor technologies have opened doors towards wireless physiological monitoring. In this presentation we will discuss methods of noninvasive physiological sensing, and its applications from medicine to clean energy. Taking advantage of wireless technology advances, Doppler radar physiological sensing has a potential to provide a compact, low cost platform for cardiopulmonary measurements. Application examples include sleep medicine, wearable systems, and occupancy sensing.

MTI2.2
AN APPROACH FOR OPTIMUM TRANSMITTER SELECTION FOR PASSIVE RADAR

Nenad Stefanović, *Department for electronic and electro-mechanic systems, TOI "Čačak", SERBIA*
Ivan Pokrajac, *Department for electronic system MTI, Belgrade, SERBIA*
Predrag Okiljević, *Department for electronic system MTI, Belgrade, SERBIA*
Nadica Kozić, *Department for electronic system MTI, Belgrade, SERBIA*

Passive air surveillance recently has drawn increased attention, as solutions for many issues became more feasible. In the essence, passive radar does not have its own transmitters, but uses illuminators of opportunity such as widely spread base stations (BS) of mobile communication systems or digital video broadcasting-terrestrial (DVB-T) transmitters. To start design of passive radar receiver, one must begin with calculating its requirements for potential usage. One of the basic requirements is range or coverage performance of radar on specific territory. In this work we use results from real measurements of BS in national cellular network and generated data from digitized topographic maps to set a scenario for finding the best relations between transmitters of opportunity and selected receiver location

as a step of radar system design. The propagation model we use here is ITU-R 1546 and signal-to-direct interference ratio (SIR) as key parameter for coverage evaluation.

MTI2.3
ANALYSIS OF RF MEMS CAPACITIVE SWITCHES BY USING NEURAL MODEL OF ACTUATION VOLTAGE

Zlatica Marinković, Faculty of Electronic Engineering, University of Niš, SERBIA
Ana Aleksić, Faculty of Electronic Engineering, University of Niš, SERBIA
Tomislav Ćirić, Faculty of Electronic Engineering, University of Niš, SERBIA
Olivera Pronić-Rančić, Faculty of Electronic Engineering, University of Niš, SERBIA
Vera Marković, Faculty of Electronic Engineering, University of Niš, SERBIA
Larissa Vietzorreck, TU München – Lehrstuhl für Hochfrequenztechnik, München, GERMANY

A challenge in RF MEMS switch design is to determine its electrical and mechanical characteristics to satisfy the application requirements. Recently, artificial neural networks (ANNs) have appeared as a very efficient simulation and optimization tool replacing time consuming simulations in standard electrical and mechanical simulators. In this paper, an ANN model relating the switch geometry parameters and the actuation voltage is used to analyse switch behaviour with changes of the bridge dimensions. Moreover, application of this model for determination of the bridge dimensions are examined. The results confirm the efficiency of the neural models and reduced time needed for device design.

MTI2.4
ANALYSIS OF HEMT NOISE WAVE TEMPERATURES FOR DIFFERENT AMBIENT TEMPERATURES

Vladica Đorđević, Innovation Center of Advanced Technologies, Niš, SERBIA
Zlatica Marinković, Faculty of Electronic Engineering, University of Niš, SERBIA
Vera Marković, Faculty of Electronic Engineering, University of Niš, SERBIA
Olivera Pronić-Rančić, Faculty of Electronic Engineering, University of Niš, SERBIA

This paper presents an analysis of the noise wave temperatures' behavior of a HEMT device working under different ambient temperature and frequency. For the purpose of extraction of the noise wave temperatures, an approach based on artificial neural networks is used. Obtained observations on the noise wave temperatures' behavior can be useful for the noise wave model accuracy improvement.

MTI2.5
INFLUENCE OF THE SECOND HARMONIC IMPEDANCE AT THE TRANSISTOR DRAIN ON THE EFFICIENCY OF RF POWER AMPLIFIER WITH THE LINEARIZATION CIRCUIT

Aleksandar Atanasković, Faculty of Electronic Engineering, University of Niš, SERBIA
Aleksandra Đorić, Innovation Centre for Advanced Technologies, Niš, SERBIA
Nataša Maleš-Ilić, Faculty of Electronic Engineering, University of Niš, SERBIA

In this paper the effect of impedance of the fundamental signal second harmonic observed at the drain of the amplifier transistor on the RF power amplifier efficiency is analysed in terms of frequency. The broadband RF power amplifier including the additional circuit for linearization is designed to opearate at frequency range 0.7 GHz to 1.2 GHz. The linearization technique applied utilizes the second- and fourth-order nonlinear signals at frequencies around the second harmonics. These signal for linearization are adjusted in amplitude and phase and injected at the amplifier transistor drain throughout the broadband matching circuit that match the impedance of the circuit for linearization to the appropriate impedance at the second harmonic observed at the drain of the amplifier transistor. Consequently, the required impedance enables high drain efficiency as well as adequite power level of the injected signal for the linearization at the transistor drain. Additionally, the amplifier linearization is performed for two-tone test characterized by different frequency interval between signals up to 100 MHz for various signal power levels.

MTI2.6
A NEW POSITION SENSOR BASED ON AN IRREGULARITY IN A PERIODIC STRUCTURE AND DEFECTED GROUND STRUCTURE (DGS)

Dušan Nešić, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Serbia

A new type of microwave position sensor is introduced. It is based on an irregularity in the periodic structure, which produces low-loss transmission resonant passband inside bandgap. The structure is simulated in microstrip technology. Irregularity in the periodic microstrip structure is above a defected ground structure (DGS). The position of a plate, which partly covers the DGS slot, is mesured according to the frequency of the peak of the resonant passband.

NEW MATERIALS – NMI

NMI1. New Materials
Chair: Nebojša Mitrović, Faculty of Technical Sciences,
Čačak, University of Kragujevac, SERBIA
Tuesday, June 09, 2015, 17:00-17:50, Room 1A

NMI 1.1
Invited paper
MAGNETIC BEHAVIOUR OF MECHANICALLY
MILLED ZnO: INFLUENCE OF MILLING MEDIA

Tatjana Srećković, Institute for Multidisciplinary Research,
Univeristy of Belgrade, SERBIA

Dilute magnetic semiconductors (DMS) can be potentially applied for spintronic devices due to their coupling of electronic and magnetic properties. Recently, experimental and theoretical investigations of DMS have drawn much attention. ZnO is a transparent semiconductor, and also it is a cheap material with a rich variety of properties. It has been widely investigated in the past decades because of its applications in optoelectronic, piezoelectric, optical, and other fields. When doped with other transition metals, ZnO can be transformed into an interesting DMS. Various experimental techniques can be used to fabricate ZnO-based DMS. Depending on the synthesis conditions, different nanoscale ZnO materials, exhibiting different magnetic properties, can be obtained. Milling in high-energy mills is one of the methods for preparation of nanocrystalline powders and, in particular, ZnO powder. If the milling assembly is carefully selected, including the milling media and parameters, it is possible to obtain large amounts of powder, with accurate control of particle and crystallite size, amount and types of defects and impurities.

The aim of this talk is to summarize the current status of zinc oxide-based DMS, and discuss the influence of synthesizing route on the structural and microstructural changes and subsequent magnetic properties of ZnO obtained during high-energy milling in steel, zirconia and wolfram carbide vessels.

NMI 1.2
EFFECTS OF ANNEALING TEMPERATURE ON THE
PHOTOLUMINISCENCE PROPERTIES OF ZrO_2 THIN
FILMS

Khaled Ali, Faculty of Physics, University of Belgrade,
SERBIA
Nenad Tadić, Faculty of Physics, University of Belgrade,
SERBIA

This work describes the photoluminescence of zirconium oxide (ZrO_2) oxide thin films synthesized using anodization method. ZrO_2 thin film annealed at different temperatures (200, 400 and 600°C). Photoluminescence excitation and emission spectra were also recorded and investigated. When the material was excited by different wavelengths, several emission bands were observed in the range of 300-500 nm. The increase of photoluminescence intensity with elevation of annealing temperature is related to reduction of OH groups, increase in the crystallinity and reduction in the non-radiated related defects. The luminescence dependence on defects in the film makes them suitable for luminescent.

NMI 1.3
THERMAL AND MAGNETIC PROPERTIES OF
$Fe_{89.8}Ni_{1.5}Si_{5.2}B_3C_{0.5}$ AMORPHOUS ALLOY

Aleksandra Kalezić-Glišović, Faculty of Technical Sciences,
Čačak, University of Kragujevac, SERBIA
Aleksa Maričić, Faculty of Technical Sciences, Čačak,
University of Kragujevac, SERBIA
Nina Obradović, Institute of Technical Sciences of SASA,
Belgrade, SERBIA
Maja Kićanović, Faculty of Technical Sciences, Čačak,
University of Kragujevac, SERBIA

This study is devoted to thermal and magnetic properties of $Fe_{89.8}Ni_{1.5}Si_{5.2}B_3C_{0.5}$ amorphous ribbon due to the effect of structural relaxation process. Thermal stabilty of amorphous alloy was investigated by differential scanning calorimetry (DSC) in the temperature range from room temperature to 900 K for as-cast samples and samples annealed at 673 K in order to attain the relaxed structure. Two step of crystallization process were observed at temperatures of about 810 K and 830 K. Magnetic propreties were investigated by measurements of frequency depenedence of magnetic hysteresis in the range of 50-1000 Hz. Initial magnetization curves were constucted and frequency dependence of total power losses refered to toroidal core mass was performed.

NUCLEAR ENGINEERING – NTI

NT1. Use of nuclear radiation
Chair: Selena Grujić, Faculty of Technical Sciences,
University of Novi Sad, Novi Sad, Serbia
Monday, June 8, 2015, 16:00-18:00, room 1C

NTI1.1
NONDESTRUCTIVE MEASUREMENTS OF ^{90}Sr AND ^{137}Cs ACTIVITY IN AQUEOUS SOLUTION USING MCNP GEOMETRY MODEL OF SEMICONDUCTOR SI DETECTOR AND GM PROBE

Selena Grujić, Faculty of Technical Sciences, University of Novi Sad, 21000 Novi Sad, SERBIA
Ivana Maksimović, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA
Miodrag Milošević, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA

This paper deals with the measurement of specific activity of ^{90}Sr in aqueous solutions in the presence of other beta emitter without chemical separation. Two methods based on the Monte Carlo simulation are used: one for semiconductor Si detector for beta spectrometric measurements and other for the Geiger-Muller (GM) ionisation probe. The MCNP geometry model of Ge detector for gamma spectrometric measurements is also presented. It was used to obtain reference value for beta/gamma radionuclide activity in sample. Finally, an example application where these methods are compared is given.

NTI1.2
RADIOLOGICAL CHARACTERIZATION OF STRONG SOURCES WITH PURE BETA EMITERS

Miodrag Milošević, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA
Ivana Maksimović, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA
Selena Grujić, Faculty of Technical Sciences, University of Novi Sad, 21000 Novi Sad, SERBIA

This paper presents a methodology prepared for the purposes of radiological characterisation of strong sources with pure beta emitters shielded with containers of unknown composition and geometry. Identification of radionuclides in these sources is based on transmission measurement of beta particles through metal plates and comparison of obtained result with experimentally and numerically obtained transmissions for known beta emitters. The emission of beta radiation and activity of identified beta emitters are determined by equating the results for beta radiation dose rate obtained with ionisation chamber and numerical simulation based on the MCNP Monte Carlo code. The final verification of identity and activity, as well as check of geometry and composition of the container containing the examined beta emitter is done by comparing the energy spectra of bremsstrahlung and the characteristic X-rays obtained by measurement with the gamma spectrometers and numerical simulation of used gamma spectrometers. These phases of radiological characterisation of pure beta emitter are illustrated in the example of the activity determination of strong source with ^{90}Sr mounted in the housing of unknown composition.

NTI1.3
ACTIVITY MEASUREMENT OF SOIL SAMPLES TAKEN IN THE VICINITY OF HANGARS H1 AND H2

Miodrag Milošević, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA
Ivana Maksimović, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA
Dragana Cekerevac-Mirković, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA

Reliable gamma-ray spectrometric measurements of ^{238}U activity over the energies of his descendants ^{234}Th at 63.29 keV and 92.59 keV and ^{234m}Pa at 1001,033 keV troubled that the obtained ^{238}U activities for selected energies have had a various values (often up to 50%). Similar problems were encountered when measuring the activities of ^{235}U, in situations where the detection of ^{235}U through three energies at 143.76 keV, 163.33 keV and 185.72 keV have been possible. The complexity of soil activity measurement comes also from the need to take into account the summing effects of X and gamma rays of radionuclides ^{152}Eu, ^{154}Eu and ^{133}Ba found in the soil in the vicinity of hangar H1 with radioactive waste on the Vinca site. Identified problems were the reason to approach the preparation procedure that could provide a reliable measurement of activities of ^{238}U, 235U, ^{152}Eu, 154Eu and ^{133}Ba. The solution was found by introducing correction factor COI for inclusion of coincidence summing effects of X and gamma rays in semiconductor Ge detector for: three energies in the chain of 238U disintegration (63.29 keV, 92.59 keV and 1001,033 keV); three energies in the ^{235}U chain (143.76 keV, 163.33 keV and 185.72 keV); one energy in the ^{152}Eu disintegration (344.28 keV); one energy in the ^{154}Eu disintegration (591.76 keV); and two energies in the ^{133}Ba disintegration (80.998 keV and 351.013 keV). This paper presents a method for measuring COI factors in the air for different positions of the point sources of ^{238}U, ^{235}U, ^{152}Eu, ^{154}Eu and ^{133}Ba. with known activity to the stationary shielded Ge detector of GX5020 type. In this process the required efficiency for selected positions of point sources are provided by using the geometrical model of Ge detectors GX5020 and the MCNP-5 Monte Carlo code. The same geometrical model and the MCNP-5 code were used for the determination of COI factors for samples with complex geometry. Finally, the results of ^{238}U, ^{235}U ^{152}Eu,

¹⁵⁴Eu and ¹³³Ba activity measurement in samples with a low content of uranium were presented.

NTI1.4

MEASUREMENT OF INTENSITY AND ENERGU SPECTRUM OF NEUTRONS EMITTED FROM Am-Li SOURCES

Ivana Maksimović, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA
Miodrag Milošević, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA
Milan Petrović, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA

The neutron energy spectrum of an 241Am–Li radionuclide source has been measured in the neutron energy range from thermal to a few MeV using a Bonner sphere set. The response functions of Bonner sphere set were derived from calculations with the MCNP Monte Carlo code. The data have been analyzed using the constrained least-squares unfolding methods. This paper describes briefly the measurements and the data analysis, and gives the neutron energy spectrum for the 241Am–Li radionuclide source.

NTI1.5

FUEL ASSEMBLY WITH DOMESTIC UO$_2$ AND POSSIBILITY OF ITS USE

Miodrag Milošević, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA
Dragana Žarković, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA
Miloš Mladenović, Public Company Nuclear Facilities of Serbia, PO Box 4, 11000 Belgrade, SERBIA

This paper presents the fuel assembly (cluster) containing 19 fuel rods with UO$_2$ of natural enrichment from domestic production. The process for the homogeneity testing of the UO$_2$ pellets, based on activity measurement of uranium (^{238}U and ^{235}U) in collimated narrow beam of gamma rays emitted from fuel rods, is described. Results tomography examination of individual UO$_2$ fuel rods with the X-radiation are also given. It has been shown that the fuel cluster with UO$_2$ from domestic production has a uniform density of UO$_2$, with a mean value of 10.443 ± 0.078 g·cm-3. Finally, an analysis of the possibility of using this cluster in heavy water nuclear reactor RB is presented.

ROBOTICS AND FLEXIBLE AUTOMATION – ROI

ROI1. Modeling, Control and Simulation
Chair: Karsten Berns, University of Kaiserslautern,
Robotic Research Laboratory, Germany
Co-chair: Branislav Borovac, Faculty of Technical
Sciences, University of Novi Sad, Serbia
Monday, June 8, 2015, 14:00-16:00, Room 1B

ROI1.1
CONTROL DESIGN FOR PICK-AND-PLACE TASK
USING ROBOT WITH INTRINSIC COMPLIANCE – QB
ROBOT

Kosta Jovanović, University of Belgrade, School of Electrical
Engineering, SERBIA
Predrag Milosavljević, Swiss Federal Institute of Technology
Lausanne (EPFL), Automatic Control Laboratory,
SWITZERLAND
Veljko Potkonjak, University of Belgrade, School of
Electrical Engineering, SERBIA

Safe human-robot interaction is one of key issues in future service robotics. Numerous researchers have already invested a lot of effort to design passively compliant robots and to investigate active compliance through control algorithms. Due to sophisticated technology, hardware platforms which enable work with passive robots are mainly not affordable to researchers worldwide. In order to bridge this gap, QB Robotics designed low cost and open source hardware platform which is presented and used in this paper. The subject of the work was 4 DoF-s compliant manipulator, programmed to execute a pick-and-place task. We demonstrate control strategy which exploits variable stiffness of the robot actuators using antagonistic nonlinear springs. Control is based on pure position measurements, without force/torque sensors necessary for advanced control techniques. Developed control algorithm is successfully tested on the experimental setup.

ROI1.2
BEHAVIOR BASED CONTROL APPROACHES FOR
NAVIGATION OF MOBILE ROBOTS IN DYNAMIC
ENVIRONMENTS

Nikola Dobrota, University of Belgrade, School of Electrical
Engineering, SERBIA
Aleksandar Ćosić, Mihajlo Pupin Institute, Robotics
Laboratory, Belgrade, SERBIA
Duško Katić, Mihajlo Pupin Institute, Robotics Laboratory,
Belgrade, SERBIA

Nowadays, wheeled mobile robots (WMR) are widely used in a variety of applications, from industry, medicine, personal assistance, security, to warehouse and distribution applications, as well as ocean and space exploration. In order to be efficient, mobile robot has to be autonomous, and in order to be autonomous, issues like robustness and flexibility play a central role, providing ability to operate and adapt to changes in realistic scenarios. WMR navigation at execution level can be split into primitive behaviors, such as going to goal, obstacle avoidance and wall following, allowing us to decompose complex problem into simple ones and build a separate controller for each of the behaviors. These three primitives are sufficient for building mobile robot complex behaviors in real world environments. In this paper, behavior based approach to mobile robot point stabilization in dynamic environments will be introduced. An approach based on fuzzy logic will be purposed, since fuzzy logic provides inherent capability of dealing with real world uncertainties and noise. Appropriate arbitration mechanism will be introduced, supposing to blend individual control actions regarding the circumstances in the environment. In order to assess performance of the proposed approach, extensive simulations in MatLAB will be carried out. It will be shown that an approach provides good results, guiding the robot successfully from start to goal.

ROI1.3
IMPLEMENTATION OF EXTENDED KALMAN FILTER
IN LOCALIZATION OF MOBILE ROBOTS

Dušan Živković, University of Belgrade, School of Electrical
Engineering, SERBIA
Aleksandar Bukvić, University of Belgrade, School of
Electrical Engineering, SERBIA
Vuk Obradović, University of Belgrade, School of Electrical
Engineering, SERBIA
Kosta Jovanović, University of Belgrade, School of Electrical
Engineering, SERBIA

The objective of this work was the implementation of extended Kalman Filter for highly accurate localization of Mobile Robots. Although the approach can be applied to localization comprising variety of sensor subsystems, we present the case employed by ETF Versus mobile robot for purposes of Eurobot competition. Therefore, developed Kalman filter synthesizes data from encoders (odometry), infrared cameras (which obtain angles between robot and beacons), and gyroscope. This paper focuses on extended Kalman filter design and tuning its parameters. An implementation of the system was carried out and results pointing out enhancements to localization are presented.

ROI1.4
ROBOT HEAD MOTION CONTROL USING HAND
GESTURES

Sofija Spasojević, Mihajlo Pupin Institute, Robotics
Laboratory, Belgrade, SERBIA
Milica Vujović, Mihajlo Pupin Institute, Robotics
Laboratory, Belgrade, SERBIA
Aleksandar Rodić, Mihajlo Pupin Institute, Robotics
Laboratory, Belgrade, SERBIA

José Santos-Victor, University of Lisbon, Institute for Systems and Robotics, Instituto Superior Técnico, PORTUGAL
Veljko Potkonjak, University of Belgrade, School of Electrical Engineering, SERBIA

In this paper, we present a new approach for robot head motion control based on the hand gestures. Appropriate robot head movements related to the different facial expressions are associated with suitable hand gesture commands. Our aim is to establish multifunctional human-robot interaction, mainly intended for patients included in the rehabilitation procedures. This study presents the first stage of the above described task – hand commands acquisition and classification. Hand gestures data are collected using commercial Cyber glove II device with eighteen sensors. All collected movements are described using quantitative measurements, based on which feature vectors for classification are formed. Obtained classification outputs are intended to be used in the process of robot head control.

ROI1.5

SYNTHETIC TEMPERAMENT OF ROBOTS

Nikola Petrović, Morena inženjering, Niš, SERBIA
Andrea Bonarini, Politecnico di Milano, ITALY
Aleksandar Rodić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA

The paper proposes a novel model of synthetic temperament, based on classic child development research conducted by Thomas, Chess and Birch. The advantages of children's personality psychological models over models related to adult humans' personality are discussed from the perspective of usage in robotics. The mappings between children's temperamental traits and mobile robot behavioral patterns are proposed. The fuzzy set theory is used to map natural language expressions, used to describe children's temperamental traits in the psychological theory, to the measured sensory inputs and robot's actuators outputs.

ROI1.6

METHODOLOGY OF SELECTING MOTOR TYPE DURING ANALYSIS, SYNTHESIS AND DESIGN OF INDUSTRIAL, HUMANOID AND CABLE-DRIVEN ROBOTIC CONFIGURATIONS

Živko Stikić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Mirjana Filipović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Ljubinko Kevac, University of Belgrade, School of Electrical Engineering, Innovation center, SERBIA

In this paper, we present a methodology for selecting the adequate type of motor for robotic mechanism. The motor, as an actuator of robotic construction, has a very important role. The need for coordination of selecting all the drives in the system includes: analysis of selecting the gear, analysis of selecting the motor and analysis of selecting the gear ratio of every axis of the robotic mechanism. This analysis is conducted for every axis of the mechanism. This analysis assumes that the mechanical construction of the system is designed and that based on its design the kinematic and dynamic models of the system are defined. However, the successive calculations of all the parameters can be adjusted to obtain the optimum solution. The detailed analysis of geometric, kinematic and dynamic parameters of the system presents a prerequisite for a good selection of motors. It should be emphasized that besides the mechanical construction of the robot, motors are one of its most expensive components. This is another important, financial, reason for the careful selection of motors.

ROI2. Robot manipulation, Kinematics and Dynamics
Chair: Aleksandar Rodić, Mihajlo Pupin Institute, Robotics Laboratory, Serbia
Co-chair: Veljko Potkonjak, School of Electrical Engineering, University of Belgrade, Serbia
Monday, June 8, 2015, 16:00-18:00, Room 1B

ROI2.1

ADAPTATION OF BIMANUAL ASSEMBLY TASKS USING ITERATIVE LEARNING FRAMEWORK

Bojan Nemec, Jožef Štefan Institute, Robotics and Biocybernetics Department, Ljubljana, SLOVENIA
Nejc Likar, Robotics and Biocybernetics Department, Ljubljana, SLOVENIA
Aleš Ude, Robotics and Biocybernetics Department, Ljubljana, SLOVENIA

The paper deals with the adaptation of bimanual assembly tasks. First, the desired policy is shown by human demonstration using kinesthetic guidance, where both trajectories and interaction forces are captured. Captured entities are portioned to both absolute and relative coordinates. During the execution, small discrepancies in object geometry as well as the influence of an imperfect control can result in large contact forces. Force control can diminish the above mentioned problems only to some extent. Therefore, we propose a framework that iteratively modifies the original demonstrated trajectory in order to increase the performance of the typical assembly tasks. The approach is validated on bimanual assembly of the standardized benchmark using two KUKA LWR robots.

ROI2.2

ASSISTED KINESTHETIC TEACHING FOR HIGHLY REDUNDANT ROBOT USING TASK PRIORITIZATION FRAMEWORK

Srđan Savić, University of Novi Sad, Faculty of Technical Sciences, SERBIA
Milutin Nikolić, University of Novi Sad, Faculty of Technical Sciences, SERBIA
Branislav Borovac, University of Novi Sad, Faculty of Technical Sciences, SERBIA

This paper presents a novel method for kinesthetic teaching of highly redundant robots. The proposed method is based on a task-oriented control through task prioritization which exploits system redundancy to enable robot to perform multiple tasks in parallel, where secondary tasks are handled without interfering with the primary ones. The proposed control algorithm provides compliant behavior of the robot end-effector, taking into account torque saturations and joint mechanical limits, and exploits system redundancy to maintain the desired robot configuration. This allows a user (demonstrator) to focus just on the task and to guide robot's end effector while the control system assists the user, choosing an appropriate configuration and maintaining the joint angles as close as possible to the desired values (e.g. middle of the joints' ranges). The method is suitable for learning robots by demonstration through physical human-robot interaction, without need for expansive motion capture system. The proposed method has been tested through a numerical simulation on a humanoid robot upper-body, consisting of two 7 DOFs (Degrees Of Freedom) arms and 6 DOFs flexible spine.

ROI2.3
SOLVING INVERSE KINEMATICS OF HYPER-REDUNDANT MULTI-LINKS FLEXIBLE MANIPULATOR – MODELING AND SIMULATION

Marija Tomić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Aleksandar Rodić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Đorđe Urukalo, Robotics Laboratory, Belgrade, SERBIA

The paper adresses a bio-inspired, multi link, hyper redundant, flexible robotic arm with 20 degrees of freedom having functions of exploration, inspection, intervention and griping in operation spaces with physical restrictions. At first, the paper regards to mechanical structure and modeling of the arm, some design aspects and solving inverse kinematical problem. Two approaches are considered: conventional numerical algorithm, and optimization algorithms. The robot consists of 10 links, 9 of them connected by two joints enabling flexion and twisting and one joint for torsion. Robot arm is terminated by robot gripper. Each section is driven by two groups of wires, controlling the bending motion in two orthogonal directions. To evaluate the design kinelatical and dynamic models are built and simulation experiments are carried out.These features makes the proposed robot well suited to confined spaces, especially for working in minimally invasive surgery, nuclear reactor pipelines, disaster debris, etc.

ROI2.4
A BIOMECHANICAL APPROACH OF FATIGUE IMPACT ON HUMAN ARM KINEMATICS IN REPETITIVE TASKS

Vladimir Petrović, University of Belgrade, School of Electrical Engineering, SERBIA
Vladimir Kojić, University of Belgrade, School of Electrical Engineering, SERBIA
Antonina Aleksić, University of Belgrade, School of Electrical Engineering, SERBIA
Mirjana Popović, University of Belgrade, School of Electrical Engineering, SERBIA
Veljko Potkonjak, University of Belgrade, School of Electrical Engineering, SERBIA

The aim of this study is to analyze effect of fatigue on human movement. In everyday life human arm commonly engages muscles and positions of joints that provide the most comfortable postures, while muscle fatigue introduces a sense of discomfort. During a repetitive task, after a sensation of discomfort, the human arm typically reduces engagement of the fatigued muscle. As a consequence, arm reconfigures itself by taking a more comfortable posture. In order to validate these assumptions, we conducted experiment where subjects performed a screw driving task. Kinematics and electromyography (EMG) were recorded during this repetitive movement. Relevant information from two study subjects were analyzed and impact of fatigue on arm reconfiguration is presented in the paper.

ROI2.5
INFLUENCE OF MECHANICAL CHARACTERISTICS OF A COMPLIANT ROBOT ON CARTESIAN IMPEDANCE CONTROL DESIGN

Branko Lukić, University of Belgrade, School of Electrical Engineering, SERBIA
Kosta Jovanović, University of Belgrade, School of Electrical Engineering, SERBIA

This paper presents the correlation of mechanical properties of a compliant robot to its Cartesian impedance control design. Firstly, a brief overview of compliant actuators in robotics, impedance control and robots with variable stiffness actuators (VSA) is outlined. Mathematical model of 2 Degrees of Freedom (DoF) robot with torsion springs is recapitulated. Dynamic of the torque based impedance control due to passive compliance in joints is examined. Torque dynamics limitations, as well as influence of mechanical properties such is motor inertia or torsion spring stiffness to the torque dynamics are evaluated.

ROI2.6
REAL-TIME ADAPTATION OF ROBOT CONSTRAINED MOTION BASED ON DISCRETE TACTILE FEEDBACK GUIDANCE

Nikola Lukić, University of Belgrade, Faculty of Mechanical Engineering, SERBIA
Petar Petrović, University of Belgrade, Faculty of Mechanical Engineering, SERBIA
Aron Alba, University of Belgrade, Faculty of Mechanical Engineering, SERBIA
Ivan Danilov, University of Belgrade, Faculty of Mechanical Engineering, SERBIA

The paper presents recent research results related to the domain of adaptive constrained robot motion control. The research was carried out at the CyberManufacturing Laboratory, Faculty of Mechanical Engineering, University of Belgrade. Adaptive control of the robot constrained motion is one of the most complex control tasks, normally performed by using force feedback. Various control schemes can be used to adapt nominal programmed robot motion and control contact forces. Although extensive theoretical background was developed through numerous research activities which span from seventies to these days, very few practical applications really exist and perform satisfactory in the industry. The reason for such unfavorable situation mostly relies in complexity of force sensing system and even more complex force signal processing. In order to solve this problem, an alternative approach is developed which is based on the discrete tactile sensing system, very simple in its construction, but very robust from a control point of view. Based on a discrete sensory signal which is presented to the robot control system input, execution of commanded motion is interrupted and fine compensation motion is generated in order to move the robot arm out of the state of collision. The control algorithm is designed in that way that in a competing manner tries to simultaneously achieve two contradictory states: the first one which moves the robot arm sufficiently faraway to avoid a state of collision - repulsive motion generator, and the second one which moves back the robot arm toward the nominal commanded trajectory - attractive motion generator. The developed adaptive motion algorithm was experimentally verified on Yaskawa SIA 10F 7 dof anthropomorphic robot arm, controlled by the open architecture control system FS 100 and the runtime software development library Yaskawa MotoPlus SDK.

ROI3. Robot design
Chair: Giuseppe Carbone, University of Casino and South Latium, Italy
Co-chair: Petar Petrović, Faculty of Mechanical Engineering, University of Belgrade, Serbia
Tuesday, June 9, 2015, 8:30-10:30, Room 1B

ROI3.1
Invited Paper
NEW CHALLENGES IN SERVICE ROBOTICS

Marco Ceccarelli, University of Cassino and South Latium, Laboratory of Robotics and Mechatronics, ITALY
Giuseppe Carbone, University of Cassino and South Latium, Laboratory of Robotics and Mechatronics, ITALY

Service robotics expands successfully applications of robotic systems in more and more non-industrial areas. New tasks are affordable by robotic systems when the peculiarities of the applications are well understood not only for technological developments but also for users' acceptance and handsome operation. Examples of emerging challenging interests are discussed in this keynote paper as referring to robot applications in areas

for surveying and restoration of goods of Cultural Heritage s well as for rehabilitating and exercising limbs of elderly people or injured patients. Mechanical aspects and features are stresses as important roles that can be successfully addressed when proper mechatronic design makes possible user-oriented operation and understanding.

ROI3.2
LOW-COST ANTHROPOMORPHIC ROBOT HAND WITH ELASTIC JOINTS

Branko Miloradović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Baran Çürüklü, Mälardalen University, Västerås, SWEDEN
Milica Vujović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Svemir Popić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Aleksandar Rodić, Robotics Laboratory, Belgrade, SERBIA

In the recent years there have been major advances in Humanoid robotics. New generation humanoids can perform lots of different tasks successfully like walking, assisting sick people and even show emotions and interact with humans. Even though this sounds promising, most of these demonstrations and applications take place in well-known environments or even in surroundings that have been modified to suite the robots capabilities and needs. However, in order to complete these tasks, the robot has to operate in large and partially or even completely unknown environments in most of the cases. If we have robots working in these types of conditions and even interact with moving objects as well as humans, collision avoidance algorithm is likely to fail. If robots operate outside of the predefined environment it is expected that they should be able to complete tasks even in case of collision. This is primarily important for robotic hands as they are the most complex, exposed and fragile part of any humanoid robot. Robotic hands have to be in the first place anthropomorphic. This means that a hand needs to possess human characteristics and not only human-like appearances.

ROI3.3
HUMAN ARTIFICIAL MUSCLE REALIZATION USING TWISTED-STRING ACTUATOR

Đorđe Urukalo, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Miloš Jovanović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Aleksandar Rodić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA

For worldwide scientific community it is a challengeable task how to realize artificial muscle. Scientific community accepts two different ways. First approach is to realize real one muscle using new synthetic materials such as piezo-electric components or pneumatic polymer materials. Second approach is to use standard electro motor together with tendon-based driving system. Here is presented a control hardware algorithm for twisted-strings

artificial muscle. Controller design is based on National Instruments Single Board RIO driving a MAXON motor type tendon driven muscle. Powerful Spartan FPGA is a key element for presented hardware implementation. To program whole system LabVIEW software is used. Simulation results for adopted model design as well as real measured experimental muscle movement under the load force are presented in the paper.

ROI3.4
HARDWARE CONTROLLER REALIZATION FOR HUMAN ARTIFICIAL MUSCLE USING TENDONS

Đorđe Urukalo, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Miloš Jovanović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Aleksandar Rodić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA

For worldwide scientific community it is a challengeable task how to realize artificial muscle.. scientific community accept two different ways. First approach is to realize real one muscle using new synthetic materials such as piezo-electric components or pneumatic polymer materials. Second approach is to use standard electro motor together with tendons. Here is presented a control hardware algorithm for tendon drive artificial muscle. Controller is based on National Instruments Single Board RIO driving a MAXON motor type tendon driven muscle. Powerful Spartan FPGA is a key element for presented hardware implementation. To program whole system a LabView software is used. Complete simulation muscle movement and real measured muscle movement is presented in the paper.

ROI3.5
MECHANICAL DESIGN OF ROBOT HEAD WITH ABILITY TO EXPRESS EMOTIONAL GESTURES

Milica Vujović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Ilija Stevanović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Aleksandar Rodić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Marko Miloš, University of Belgrade, Faculty of Mechanical Engineering, SERBIA

Mechanical design of robot head, presented in this paper, is based on humanoid face form, made of rigid plastic and various mechanisms for eyeballs, eyelids, lips and eyebrow movement. The idea was to create a platform for the expression of human emotions with combination of movements of certain parts of the system. Analyzing the basic face expressions in regard of emotions that the human face can produce and fitting them into the limitations that are set, mobile parts are defined in order to enable the achievement of desired conditions. The movable mechanisms are based on the levers, shafts, spheres and customized parts which are driven by the RC engine placed in the inside of the head. They initiate movement of elements (eyeballs, eyelids, lower jaw, lips

and eyebrows), so that a combination of these movements generate different expressions. 90% of the parts used in this system are produced by 3d printing technology in order to make simple parts that together form complex conditions.

ROI3.6
IMPORTANCE OF DEVELOPMENT AND APPLICATION AREAS OF DIFFERENT STRUCTURES OF CABLE-SUSPENDED PARALLEL ROBOT – CPR SYSTEMS

Mirjana Filipović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Ljubinko Kevac, University of Belgrade, School of Elctrical Engineering, Innovation center, SERBIA
Ana Đurić, Wayne State University, Detroit, US
Milica Vujović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA

In this paper, we present several new types of Cable-suspended Parallel Robots – CPR systems. We point out their advantages compared to the previously published solutions. The development of these systems provides wide possibilities for their application in diverse areas of human activity: 1. surveillance and recording the workspace for various purposes: securing and monitoring the workplace, 2. recording and monitoring mass sporting (football, hockey, tennis, ...) and cultural events, 3. supervision and support to children, elderly and disabled persons, 4. watering in greenhouses and open plantations, and 5. applications for security, police and military use. The logic of monitoring the target object can be applied to conventional robotic systems in many other areas of research. Analysis, synthesis and development of these systems has a special significance, because in Serbia and in its wider surrounding, this system has not yet been created.

ROI4. Robot intelligence, vision, sensing and implementation
Chair: Bojan Nemec, Jožef Štefan Institute, Robotics and Biocybernetics Laboratory, Slovenia
Co-chair: Mirjana Popović, University of Belgrade, School of Electrical Engineering, Serbia
Tuesday, June 9, 2015, 15:00-17:00, Room 1B

ROI4.1
ROBOT OPERATING SYSTEM AND ITS IMPLEMENTATION TO THE PC ARCHITECTURE

Stefan Dragićević, University Union, Belgrade, SERBIA
Miloš Jovanović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA

Prevalent problem in robotic development was that engineers lacked common platform for communication and collaboration. Every time they started a new project they needed to build software and hardware from the beginning. To overcome this problem various robotic platforms were developed and today's leading platform

for robotics is Robot Operating System (ROS). ROS is intending to be worldwide useful robotic operation system as well as for industrial applications and scientific research. The paper presents a main concept of the ROS, advantages and comparison of ROS and other frameworks used in robotics. PC implementation and using PC platform as a robotic controller is the main goal of the paper.

ROI4.2
ON BUILDING REMOTELY OPERATED UNDERWATER ROBOT-EXPLORER WITH BI-MANUAL POLY-ARTICULAR SYSTEM

Aleksandar Rodić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Ilija Stevanović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Miloš Jovanović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Đorđe Urukalo, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA

Development of the river underwater robot-grebe is intended for guided underwater search, underwater camera shooting, monitoring and inspection of objects submerged in the water, underwater installation, rescue missions, ecologic tasks, sampling of river bottom material and assistance in extraction of submerged objects from the river. Prototype of underwater robot-explorer is intended for use in the big and smooth (not turbulent, highland) rivers. Mechanical structure, rigid body dynamics, poly-articulated robot-arms, hydrodynamic characteristics, modeling and simulation are presented in the paper. Based on simulation of rigid body dynamics affected by water current, appropriate choice of thruster motors that power underwater robot is done. Some implementation aspects are considered based on analysis of simulation results.

ROI4.3
STRATIFIED VISUAL 3D FEEDBACK FOR ADAPTIVE ROBOTIC ARC-WELDING

Ivan Danilov, University of Belgrade, Faculty of Mechanical Engineering, SERBIA
Petar Petrović, University of Belgrade, Faculty of Mechanical Engineering, SERBIA
Filip Korać, University of Belgrade, Faculty of Mechanical Engineering, SERBIA
Nikola Lukić, University of Belgrade, Faculty of Mechanical Engineering, SERBIA

The paper presents recent research results related to the domain of adaptive robotic arc-welding systems, carried out at the CyberManufacturing Laboratory, Faculty of Mechanical Engineering, University of Belgrade. We have used stratified visual 3d feedback in order to provide a robot control system to autonomously and robustly adapt the nominal welding plan to the true location (position and orientation) and internal geometry of the weldment (assembly to be welded). The proposed system consists of two sensory strata. At the higher stratum, low resolution vision sensor based on TOF technology is used for fast geometry acquisition of the weldment and neighboring working space. Multiple views are used and for each of them, 3d point cloud consisting of thousands of points is generated, and then merged by applying the ICP registration algorithm. In order to provide near-real-time performance, and thus significantly speed up geometry acquisition, ICP algorithm was adapted in the way that the robot Cartesian coordinates are incorporated into the algorithm. By this adaptation shorter iteration sequence and convergence toward the global minimum are achieved. Once obtained, completely merged 3d point cloud of the weldment, generated by the sensory data, was additionally registered using as a reference model the 3d point cloud generated from the CAD model of the weldment, again using adapted ICP algorithm. In parallel, Hausdorff distance was used for identification of the weldment internal geometry deviation. As a result of this algorithmically complex but computationally efficient procedure, location of the weldment is determined, with such accuracy which allows the replanned welding task to be effectively handled with the high-resolution sensory system at the lower visual feedback stratum. The lower stratum is based on high-resolution laser triangulation line sensor, which can generate additional information content, necessary to accurately compensate location errors as well as errors of the internal geometry of the weldment. Since the overall procedure can be completely realized without the human operator intervention, the developed system has high practical value for small lot sizes, including lot size one (one-of-a-kind production). Functionality the developed stratified visual 3d feedback concept is experimentally verified in laboratory conditions, under the real industrial scenario of the robotic arc-welding.

ROI4.4
MODULAR RECONFIGURABLE ROBOTS IN MODERN ADAPTIVE AND FLEXIBLE PRODUCTION SYSTEMS

Svemir Popić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Miloš Jovanović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Branko Miloradović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA

A dramatical decrease of the production cycle's life-span sets additional requirements on additivity and reconfigurability of the modern production systems. Modular reconfigurable robots enable fast adaptation of the modern production system to the requirements of the new product's production cycle. This paper presents the design of small industrial robots using single-joint, two-joint, and three-joint modules. Such modules allow for different robot system's configurations and degrees of freedom (DOF) depending on the concrete needs of the production system. In the paper, the design of these modules is presented, the applied control system, based on the ROS operational system implemented onto the AVR control board system together with the smart serial sensor communication, internal cable implementation and mechanical and electrical interfaces suitable for a simple

reconfiguration of the robot system by the appropriate joints and simple links between the joints.

ROI4.5
REMOTE CONTROL AND DATA ACQUISITION OF ROBOTIC MECHANISMS

Ljubinko Kevac, University of Belgrade, School of Electrical Engineering, Innovation center, SERBIA
Svetislav Ćirić, University of Belgrade, School of Electrical Engineering, SERBIA
Miloš Jovanović, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA
Aleksandar Rodić, Mihajlo Pupin Institute, Robotics Laboratory, Belgrade, SERBIA

In this paper we present a system for remote control and data acquisition of any kind of robotic mechanism. This remote system consists of a Geneko's GWR352 cellular modem (3G router) and National Instruments' sbRIO-9636 board. GWR352 presents a robust, high performance 3G router designed to meet the requirements of large number of machine-to-machine applications, while the NI sbRIO 9636 presents a powerfull embedded device used for different industrial applications. These two devices are connected with ethernet cable and they communicate via OpenVPN tunnel. On the other side, the NI sbRIO-9636 board is connected with a robotic mechanism and it is used for control of the mechanism. The user can use their cell phone to send data (via GRW352 3G router) to sbRIO and control the mechanism. Also, the user can access the data from the mechanism and track the behaviour of the system.

ROI4.6
ROBOT TOOL CENTRE POINT CALIBRATION USING ANALYSIS OF IMAGES FROM ORTHOGONAL PLANES

Claudio Ongaro, Advanced Automation Technologies srl, Conegliano TV, ITALIA
Zaviša Gordić, University of Belgrade, School of Electrical Engineering, SERBIA

Robot Tool Centre Point (TCP) calibration problem is of great importance for a number of industrial applications, and it is well known both in theory and in practice. Although various techniques have been proposed for solving this problem, they mostly require tool jogging or long processing time, both of which affect process performance by extending cycle time. This paper presents an innovative way of 5-dimension TCP calibration using a set of two cameras. The robot tool is placed in an area where images in two orthogonal planes are acquired using cameras. Using robust pattern recognition, even deformed tool can be identified on images, and information about its current position and orientation forwarded to control unit for calibration. Compared to other techniques, test results show significant reduction in procedure complexity and calibration time. These improvements enable more frequent TCP checking and recalibration during production, thus improving the product quality.

COMPUTERS – RTI

RTI1.1
MTD(F) HEURISTIC IN ACHILLES CHESS ENGINE ALPHABETA PROCEDURE

Vladan Vučković, Faculty of Electronic Engineering, University of Niš, Niš, SERBIA

This paper presents the methods to embed heuristic in standard Alpha-Beta searchers. As the framework for this improvement basic Alpha-Beta procedure is defined. Some original modifications and methods for improvement are presented. All of these theoretical results and novelties are successfully implemented and verified in authors' chess applications Axon and Achilles.

RTI1.2
EMBEDDED PLATFORM MEMORY MAP VISUALIZATION

Stefan Stanivuk, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Momčilo Krunić, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Djordje Petrović, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Jelena Kovačević, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Robert Peckai-Kovač, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA

This paper describes one solution of a software tool used for embedded platform memory map visualization. Information obtained from memory map is graphically displayed in a vivid manner where each symbol that allocates some memory words is graphically outlined with a specific memory name, address and size. This tool is developed using the Tcl (Tool Command Language) scripting language with the Tk package toolkit that is used for GUI (Graphical User Interface) widgets development. Validation of implemented solution was accomplished through the comparison of data obtained from the tool output against expected data generated by the Matlab script.

RTI1.3
BUILDING BLOCKS FOR GUI – NOVEL SOLUTION FOR COMPOSITE COMPONENT MANAGEMENT

Djordje Kovačević, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Violeta Vukobrat, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Stefan Pejić, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Istvan Papp, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA

This paper introduces a framework for Graphical User Interface (GUI) application development and focuses on its basic components - widgets. Widgets can be combined to form components of higher complexity. This ability also revealed a problem of managing composite components. Existing solutions do not offer flexibility in features design. In this paper we present a novel idea in which we arranged the elements to address problematic features and also created a framework to arrange the elements in 3D space.

RTI1.4
MULTI PROCESS STB MIDDLEWARE SOLUTION

Marko Brett, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Laslo Benarik, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Ognjen Bjeković, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Milan Savić, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA

This paper proposes a multi process STB middleware using D-bus inter-process communication protocol. The proposed middleware also uses QtWebKit for graphics rendering and interacting with Web content. The purpose of dividing the STB middleware into multiple processes is to increase security and enable a more flexible approach for adding new features from different parties.

RTI1.5
A FAST-SHOOTING VIDEO GRABBING SYSTEM FOR BLACK BOX TESTING BASED FRAMEWORKS

Branislav Kordić, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Darko Lulić, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Vukota Peković, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Ivan Kaštelan, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA

Due to considerably increased number of features provided by modern consumer devices, automated, fast and reliable testing frameworks are necessity. This paper presents a fast-shooting video grabbing system for a black box testing based frameworks. The fast-shooting video grabbing system aims to provide: (i) remote control of a testing system, (ii) automated tests execution, as well as (iii) ability to perform fast imageand real-time video grabbing of DUT's output. The ideas behind thefast-shooting video grabbing system are to provide high-speed

image and real-time video capturing, automated test execution with low execution overheads, and system modularity. The system is evaluated by means of a particular case study. As system performance measures experimental results for image grabbing functionality are given. Lessons learned are addressed to potential problems and bottlenecks faced during system implementation.

RTI1.6
USING HISTOGRAMS TO IMPROVE WEATHER HAZARDOUS EVENTS PREDICTION

Marko Kovačević, Innovation Centre of Advanced Technologies Ltd., Niš, SERBIA
Vladan Mihajlović, Faculty of Electronic Engineering, University of Niš, Niš, SERBIA
Dejan Rančić, Faculty of Electronic Engineering, University of Niš, Niš, SERBIA

Weather radar data are valuable because of high spatial and temporal resolution and strong correlation with precipitation. Extracting important information from such data using different methods of analysis and visualization is crucial in weather forecast and weather hazardous events prediction. The aim of this research is to explore the use of histograms for prediction of weather hazardous events, like hailstorms and heavy rain storms, that are usually very quick to evolve. Difference between consecutive histograms and appropriate histogram visualization can provide valuable information regarding magnitude and speed of cloud creation, which can then be used by weather experts to improve the process of identifying potential creation of weather hazardous events. As histogram creation and manipulation is not a computationally intensive task, the developed method is very efficient and can be used in real time.

RTI2. Computing Session II
Chair: Ivan Milentijević, Faculty of Electronic Enginering Niš, Serbia
Tuesday, June 9, 2015, 17:00-19:00, Kamin Room

RTI2.1
IMPLEMENTATION OF IOT HOME AUTOMATION GATEWAY WITH CLOUD CONNECTIVITY OVER TR-069 PROTOCOL

Milan Savić, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Istvan Papp, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Dragan Rakita, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Saša Radovanović, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Nemanja Ignjatov, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA

This paper proposes and evaluates design, operation and implementation of IoT gateway device with cloud connectivity over TR-069 protocol. We live in the time where the number of IoT devices increases by the minute. That leaves space for security issues to arise as every device has a connection to the internet and therefore every device can be a subject of cyber attack. Proposed IoT gateway represents a mediator between devices (sensors, actuators,..) and open internet. Security threats are reduced to minimum as gateway unlike devices has capability to run more complex programs and consequent to that have better security level. IoT concept is preserved with use of TR-069 protocol for cloud connectivity. That way all IoT devices in the household are still reachable over internet.

RTI2.2
COMPARISON OF THE AVAILABLE TOOLS FOR WEB AUTOMATED TESTING

Milivoj Božić, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Bojan Mrazovac, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Istvan Papp, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Aleksandar Živković, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA

During the development of the web applications developers often face the lack of testing phase due to time pressure. This phase must be approached seriously and every element of the web application must be verified. It is not rare case that web application that was not properly tested stops responding after a while. This paper presents a process of automated testing of the web applications. Several tools for web automated testing have been presented and compared: Sikuli, Selenium and AutoIt tool. Comparison analysis of presented tools is given in order to help the developers to determine the best choice for specific applications and situations.

RTI2.3
CUSTOM TOOLCHAIN INTEGRATION INTO THE ECLIPSE BASED IDE

Momčilo Krunić, RT-RK Institute for Computer Based Systems, Novi Sad, SERBIA
Nenad Cetić, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Ivan Považan, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA
Miroslav Popović, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, SERBIA

Toolchain plays a vital role in software development for embedded systems. It consists of tools that form a toolchain which main goal is to transform input source files to the executable image. This paper describes the integration of such toolchain into the Eclipse based Integrated Development Environment (IDE). The essential purpose of IDE is the toolchain integrations since the toolchain represents a cornerstone of software development process. For that purpose C/C++ Development Tools (CDT) Managed Build Definitions

extension point was used. The final product (IDE) contains two custom toolchains that have the possibility of exchanging related links. Validation is performed through execution of JUnit, DejGnu and Squish tests developed to take under test project building mechanism, toolchain and graphical user inderface (GUI) elements. The validation covers various available toolchain configurations.

RTI2.4
S4: SIMULATOR FOR LEARNING SENSOR NETWORKS

Milan Škarić, School of Electrical Engineering, University of Belgrade, Belgrade, SERBIA
Aleksandar Ivanović, School of Computing, Union University, Belgrade, SERBIA

Our main goal was to create a working environment for PhD students for the learning, testing and prototyping of new ideas in computer networking, load balancing, fault tolerance and routing protocols. Especially, we introduced concepts of spectral partitioning into computer networks which is a promising concept for research of new routing algorithms. Our goal was to create a simulator which is visual, intuitive and interactive.

RTI2.5
OPTIMIZED ONE ITERATION MAPREDUCE ALGORITHM FOR MATRIX MULTIPLICATION

Filip Živanović, Faculty of Electronic Engineering, University of Niš, Niš, SERBIA
Vladimir Ćirić, Faculty of Electronic Engineering, University of Niš, Niš, SERBIA
Natalija Stojanović, Faculty of Electronic Engineering, University of Niš, Niš, SERBIA
Ivan Milentijević, Faculty of Electronic Engineering, University of Niš, Niš, SERBIA

For the last several years Cloud Computing is becoming dominant technology for big data processing. Apache Hadoop, as one of the frameworks for data storage and computing on the cloud, in the form of PaaS using MapReduce paradigm, is widely adopted among both developers and researchers. Taking into the account great importance of matrix multiplication in computer science in general, the goal of this paper is development of new MapReduce algorithm for matrix multiplication, which is able to perform the multiplication in one iteration. The proposed one iteration MapReduce algorithm is optimized by prearranging the input data in such manner that matrix elements can be fetched in sequential order. The proposed algorithm is presented in detail. The implementation results are given. The results obtained on the cluster with 20 nodes are discussed.

TELECOMMUNICATIONS – TEI

TEI1. Telecommunications
Chair: Nenad Milošević, Faculty of Electronic Enginering Niš, Serbia
Tuesday, June 9, 2015, 15:00-17:00, Room 2

TEI1.1
Invited Talk
SPECTRUM SENSING COORDINATION FOR FIRE LTE
TESTBEDS

Milorad Tošić, Faculty of Electronic Engineering, University of Niš, 14 Aleksandra Medvedeva, 18000 Niš, SERBIA
Zorica Nikolić, Faculty of Electronic Engineering, University of Niš, 14 Aleksandra Medvedeva, 18000 Niš, SERBIA
Valentina Nejković, Faculty of Electronic Engineering, University of Niš, 14 Aleksandra Medvedeva, 18000 Niš, SERBIA
Bojan Dimitrijević, Faculty of Electronic Engineering, University of Niš, 14 Aleksandra Medvedeva, 18000 Niš, SERBIA
Nenad Milošević, Faculty of Electronic Engineering, University of Niš, 14 Aleksandra Medvedeva, 18000 Niš, SERBIA

One of the main challenges for modern telecommunication systems is the pressure to keep up with constantly increasing requirements for higher data rates. This is particularly critical for mobile communication systems, due to limited spectrum availability. Even though the Long Term Evolution (LTE) standard provides high data rates, it may not be enough for future demands. The higher spectrum bandwidth can be achieved through the combined use of licensed and unlicensed spectrum. LTE-Advanced has introduced a mechanism, named carrier aggregation, which is the key technology that enables the unlicensed spectrum usage (LTE-U). However, in order to use the unlicensed spectrum, there has to be a coordination between the LTE and the native unlicensed spectrum users, such as WiFi or Bluetooth. The first step in the spectrum usage coordination is to obtain the spectrum usage data by spectrum sensing. This paper presents an experimentation framework under development that will be able to support LTE-U experimentation involving different spectrum sensing and spectrum coordination mechanisms. Semantic descriptions and spectrum sensing ontology will be adopted to facilitate cognitive coordination mechanisms. The experimentation is aimed at the coordination between the WiFi and LTE users at 5GHz band, but because of the semantic descriptions, it is flexible enough to support other frequency bands and other technologies as well.

TEI1.2
IPsec PROTOCOL IMPLEMENTATION WITH QUAGGA
SOFTWARE

Hasan Redžović, School of Electrical Engineering, University of Belgrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, SERBIA
Aleksandra Smiljanić, School of Electrical Engineering, University of Belgrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, SERBIA

Virtual Private Networks (VPNs) allow secured communication between two or more parties (or networks). Some organizations use hardware VPN solutions to provide security for data transfer, while others use software or protocol-based implementations. There are several open-source VPN solutions for Linux like strongSwan, Openswan and others that utilize a standardized Internet Protocol Security (IPsec) implementation. Open-source routing suite Quagga implements routing protocols using also Linux operating system. Quagga combined with strongSwan is a free software solution that can be used in many different VPN implementations. In this paper, we examine how these two software products work together and how they use Linux kernel for processing packets. We present implementation and configuration of the IPsec protocol. At the end, we test capabilities of the implemented VPN solution, and evaluate its performance.

TEI1.3
PARALLEL SINGLE SOURCE SHORTEST PATH
ALGORITHM WITH PARALLEL VERTEX TRAVERSAL

Mihailo Vesović, School of Electrical Engineering, University of Belgrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, SERBIA
Dušan Kostić, School of Electrical Engineering, University of Belgrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, SERBIA
Aleksandra Smiljanić, School of Electrical Engineering, University of Belgrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, SERBIA

One of the most important problems in graph theory is a single source shortest path problem (SSSP). SSSP is well-studied problem with wide range of applications, from network routing to VLSI design. SSSP problem is defined as finding shortest paths from source vertex to all other vertices in graph. Dijkstra is theoretically most efficient algorithm for solving SSSP problem and therefore most widely used. Another widely used algorithm is Bellman-Ford algorithm, because of its simple implementation. In this paper, we present a parallel implementation of single source shortest path algorithm with parallel vertex traversal. We analyze performance of proposed implementation for common data center network topologies and compare it to sequential implementations of Dijkstra and Bellman-Ford algorithms.

TEI1.4
INTERMODULATION PRODUCTS DUE TO DOWNCONVERSION MIXER IN SATELLITE SYSTEMS

Hana Stefanović, High School of Electrical Engineering and Computer Science, Vojvode Stepe 283, 11000 Belgrade, SERBIA
Dejan Milić, Faculty of Electronic Engineering, University of Nis, Aleksandra Medvedeva 14, 18000 Nis, SERBIA

In this paper the downconverting mixer model is proposed, in order to translate the uplink frequency to the downlink frequency in C-band and Ku-band satellite transponders. An impact of intermodilation (IM) components produced by mixer, in addition to the desired output frequency, is analyzed under different conditions. An effect of bandpass filtering after frequency conversion in order to mitigate IM products is analyzed, while low-noise amplifier (LNA) is applied before frequency conversion process.

TEI1.5
SWITCH-AND-STAY RECEPTION OVER κ - µ SHADOWED FADING CHANNELS IN THE PRESENCE OF CO-CHANNEL INTERFERENCE

Darko Vučković, Faculty of Technical Sciences, University of Pristina, Kneza Miloša 7, 38220 Kosovska Mitrovica, SERBIA
Stefan Panić, Faculty of Natural Sciences and Mathematics, University of Pristina, Lole Ribara 29, 38220 Kosovska Mitrovica, SERBIA
Petar Spalević, Faculty of Technical Sciences, University of Pristina, Kneza Miloša 7, 38220 Kosovska Mitrovica, SERBIA
Branimir Jakšić, Faculty of Technical Sciences, University of Pristina, Kneza Miloša 7, 38220 Kosovska Mitrovica, SERBIA
Časlav Stefanović, Faculty of Natural Sciences and Mathematics, University of Pristina, Lole Ribara 29, 38220 Kosovska Mitrovica, SERBIA

In this paper wireless transmission over κ-µ shadowed fading channels in the presence of co-channel interference will be analyzed. First, closed-form expressions will be derived for the probability density function (PDF) and cumulative distribution function (CDF) of equivalent signal-to-interference ratio (SIR) process. Further, dual-branch SSC reception will be observed, and PDF and CDF expressions for output SIR will be derived in the closed form. Finaly, some of the performance measures, such are outage probability (OP) and average bit error rate (ABER) over some modulation schemes, will be efficiently evaluated, graphically presented and discussed in the function of system parameters

TEI1.6
PERFORMANCE ANALYSIS OF IoT WIRELESS SENSOR NETWORKS FOR HEALTHCARE APPLICATION

Dejana Ugrenović, Faculty of Electrical Engineering, University of Banja Luka, Patre 5, 78000 Banjaluka, BiH
Gordana Gardašević, Faculty of Electrical Engineering, University of Banja Luka, Patre 5, 78000 Banjaluka, BiH

Internet of Things represents the network of physical sensors that are able to sense changes in environment and communicate between each other, as well as to send data to external environment. Applications in healthcare are an emerging field in Internet of Things research area. The aim of this paper is to analyze the transmission properties of different type of data used in medicinal applications and to measure the performance by means of throughput, packet loss rate and latency. The healthcare scenario is based on 6LoWPAN (IPv6 over Low power Wireless Personal Area Networks) protocol stack within the Contiki operating system and Cooja simulator.

TEI2. Telecommunications
Chair: Aleksandra Smiljanić, University of Belgrade, School of Electrical Engineering, Belgrade, SERBIA
Tuesday, June 9, 2015, 17:00-19:00, Room 2

TEI2.1
Invited Paper
NON-REFERENCED OBJECTIVE STREAMING VIDEO QUALITY EVALUATION IN CELLULAR NETWORKS OF 3rd AND 4th GENERATION

Ivica Kostanić, Florida Institute of Technology, Melbourne, FL USA
Hamad Almohamedh, Florida Institute of Technology, Melbourne, FL USA
Fahad Alqurashi, Florida Institute of Technology, Melbourne, FL USA

This talk presents a novel methodology for quality evaluation of streaming video data services. The methodology requires no reference and it predicts subjective experience of the video quality. The predictions are based on a nonlinear mapping between objective technical metrics collected by the user equipment and subjective scores given by human evaluators. The objective metrics may be taken from various levels of the protocol stack. In the current implementation, the nonlinear mapping is accomplished through a neural network.The performance of the methodology has been tested using data UDP streaming video services over LTE (4G) and HSPA (3G). The agreement between the predictions and subjective quality evaluation scores is excellent.

TEI2.2
ADDITION TO PROTOCOL FOR SATELLITE, CABLE AND TERRESTRIAL SIGNAL DISTRIBUTION OVER IP NETWORKS

Milan Aćanski, RT-RK Institute for Computer Based systems, Novi Sad, SERBIA
Ilija Bašićević, Faculty of Technical Sciences, University of Novi Sad, 21000 Novi Sad, SERBIA
Jelena Kovačević, Faculty of Technical Sciences, University of Novi Sad, 21000 Novi Sad, SERBIA

Milan Savić, RT-RK Institute for Computer Based systems, 21000 Novi Sad, SERBIA

Latest trends for live media content broadcast over IP networks motivated development of SAT>IP protocol which defines control and distribution of satellite, cable and terrestrial contend over IP networks. This document describes protocol and its usage scenarios. Considering usage scenarios and noticed limitations, proposed is protocol upgrade with goal to improve server resource management.

TEI2.3
REVENUE-SHARING AGREEMENT FOR CONTENT AND SERVICE PROVIDERS INTERCONNECTION

Branka Mikavica, Faculty of Transport and Traffic Engineering, University of Belgrade, 305 Vojvode Stepe, 11000 Belgrade, SERBIA
Aleksandra Kostić-Ljubisavljević, Faculty of Transport and Traffic Engineering, University of Belgrade, 305 Vojvode Stepe, 11000 Belgrade, SERBIA
Vesna Radonjić Djogatović, Faculty of Transport and Traffic Engineering, University of Belgrade, 305 Vojvode Stepe, 11000 Belgrade, SERBIA

This paper analyses vertical and horizontal interconnection between Content and Service Providers. Vertical interconnection is agreed upon on Revenue-Sharing basis. Providers' incentives of horizontal interconnection introduction when network resources might be congested are analysed. Capacity based Revenue-Sharing agreement is proposed in order to improve fairness and to assure satisfactory values for customers' utility.

TEI2.4
ON THE IMPACT OF NETWORK LOAD ON LTE NETWORK DOWNLINK PERFORMANCE

Milutin S. Davidović, Ericsson d.o.o, Milentija Popovica 5a, 11070, Belgrade, SERBIA
Sanja M. Bjeković, Ericsson d.o.o, Milentija Popovica 5a, 11070, Belgrade, SERBIA
Igor A.Tomić, Ericsson d.o.o, Milentija Popovica 5a, 11070, Belgrade, SERBIA

Throughput is one of the main network performance indicators, as it is of the most importance for end user experience. In this paper, analysis of correlation between downlink throughput and level of signal, measured as Reference Signal Received Power (RSRP) in LTE network will be performed. Furthermore, the impact of network load on downlink throughput in LTE network will be analyzed.

TEI2.5
COMPARISON OF TWO FORECASTING METHODS OF MOBILE TELEPHONY TRAFFIC

Suzana Miladić, Faculty of Transport and Traffic Engineering, University of East Sarajevo, 52 Vojvode Mišića, 74 000 Doboj, BOSNIA AND HERZEGOVINA

Goran Marković, Transport and Traffic Engineering, University of Belgrade, 305 Vojvode Stepe, 11 000 Belgrade, SERBIA
Valentina Radojičić, Faculty of Transport and Traffic Engineering, University of Belgrade, 305 Vojvode Stepe, 11 000 Belgrade, SERBIA

This paper presents two traffic forecasting methods applied to the cellular mobile network of the incumbent telecom operator in the Republic of Srpska. The first one is an econometric method that deals with several explanatory variables affecting the changes to the traffic volume. A regression analysis is used for estimation the model parameters. The total monthly traffic minutes is chosen as a suitable metric of traffic volume. The second traffic forecasting method is based on Bass diffusion model for estimation the number of mobile users. It takes into the consideration three diffusion parameters: parameters of innovation, imitation and market potential. Throughout the numerical example the short-term forecasted results of mobile telephony traffic are given.

TEI2.6
DEPLOYMENT OF TELEVISION WHITE SPACE SOLUTIONS IN UNDERGROUND COMMUNICATIONS

Dejan Vujić, Indigo Broadband, 1 Westlake Drive, Tokai 7945, Cape Town, REPUBLIC OF SOUTH AFRICA
Miroslav L. Dukić, Technical Faculty, Singidunum University, Danijelova 32, 11000 Belgrade, SERBIA

Television white space (TVWS) solutions had been deployed in above ground communication systems and networks providing data connectivity for different applications, but its deployment for underground communications has not been tested so far. It was demonstrated in a mine exploiting platinum ore that underground communication using TVWS solutions is possible and that such solutions could provide data connectivity with UDP level throughputs of the order of 2Mb/s for distances of 350m. It was demonstrated that TVWS could be combined with Wi-Fi networks in 2.4GHz and 5GHz for connecting standard smart devices from underground to above ground communication systems and Internet.

TEI2.7
APPLICATION FOR QUALITY OF SERVICE NEGOTIATION AND MANAGEMENT IN IP-BASED NETWORKS

Slavica Bostjančić Rakas, Mihailo Pupin Institute, University of Belgrade, 13 Volgina, 11060 Belgrade, SERBIA
Mirjana Stojanović, Faculty of Traffic and Transport Engineering, University of Belgrade, 305 Vojvode Stepe, 11000Beograd, SERBIA
Valentina Timčenko, Mihailo Pupin Institute, University of Belgrade, 13 Volgina, 11060 Belgrade, SERBIA

In this paper application for negotiation and management of quality of service in environment of IP-based network has been described. Application is developed with object-oriented programming, using C++ programming

language. The application allows configuration of the quality of service parameters, classification and admission control of new traffic flows, as well as appropriate resource allocation taking into account quality of service requirements and specific characteristics of the domains.

Functional model of the application encompasses following entities: user agent, class selector, network resource management and administrator entity.

ARTIFICIAL INTELLIGENCE – VII

VI1. Mathematical models in artificial intelligence
Chair: Aleksandar Perović, Faculty of Traffics, Belgrade, SERBIA
Thursday, June 11, 2015, 10:30-12:30, Room 1C

VII.1.1
TYPES IN UNIFICATION THEORY

Obrad Kasum, GIS, Group for Intelligent Systems, Faculty of Mathematics, Belgrade, SERBIA

When the syntactical unification is considered, for two unifiable terms there is always an unifier which is more general (smaller) than every other (an MGU). However, in a general case of E-unification, there is no MGU. Instead, we work with (minimal) dense sets of unifiers. The type of unification problem is determined with the minimal cardinality of a minimal dense set of unifiers. We present here an overview of some facts about types.

VII.1.2
REMARK ON CONTINUOUS KNOWLEDGE REPRESENTATIONS

Aleksandar Jovanovic, GIS, Group for Intelligent Systems, Faculty of Mathematics, Belgrade/State Un. Novi Pazar, SERBIA

We discuss knowledge representations of continuous nature, as common in signal/image sensor originating, for which the natural organisation is within metric spaces. The role of metrics provides methods for object retrieval and recognition, with comparison to the representative cases. Naturally, the representation space distance - metrics is continuous, thus offering proper definition of approximation and approximation degrees, which are implemented straightforward when metrics is well (analytically) determined.

VII.1.3
A NOTE ON REASONING UNCERTAINITY

Aleksandar Perović, Faculty of Traffics, Belgrade, SERBIA
Edin Dolićanin, GIS, Group for Intelligent State Un. Novi Pazar, SERBIA
Aleksandar Jovanović, GIS, Group for Intelligent Systems, Faculty of Mathematics, Belgrade/State Un. Novi Pazar, SERBIA

In this talk we shall give an overview of the mainstream logical techniques used over the last three decades for mathematical representation of uncertainty. The focus will be on so called weighted logics (probabilistic, fuzzy, possibilistic) as a natural mathematical environment for expressing uncertainty.

VII.1.4
A MEMETIC ALGORITHM FOR SOLVING QUADRATIC ASSIGNMENT PROBLEM

Dušan Džamić, Faculty of Organizational Sciences, University of Belgrade, SERBIA
Miroslav Marić, Faculty of Mathematics, University of Belgrade, SERBIA
Bojana Lazović, Belgrade Business School, SERBIA

Quadratic Assignment Problem (QAP) is a well-known NP-hard combinatorial optimization problem with a diverse set of applications. In this paper, we present a population-based heuristic algorithm for QAP. The main contribution of this paper is to develop a new approach memetic algorithm (MA) for QAP which combines an effective local search algorithm, a crossover operator and an adaptive mutation mechanism. The proposed MA algorithm is tested on the instances from QAPLIB. Experimental results show that the proposed MA algorithm performs very well on these instances.

VII.1.5
INTERACTIVE IMAGE SEGMENTASTION USING FUZZY LOGIC

Nebojša Perić, Faculty of Mathematics, University of Belgrade, SERBIA

In this paper we will show a way how to conduct segmentation and extract objects in digital images. Image segmentation is of fundamental importance in many intelligent and complex systems, and therefore there is always a need to find a better and perhaps a not so complicated algorithm to implement. It is often a case that we cannot conduct automatic image segmentation, and this will show how to do image segmentation (for example: Determine foreground and background of image) with little human interference. The motivation for this paper was to find a faster and a elegant approach in image segmentation and extraction of desired objects. In this paper we will describe tools from image processing and fuzzy logic that we use for interactive image segmentation as well as the proposed algorithm.

VII.1.6
DEFALT REASONING AND PROBABILITY

Aleksandar Perović, Faculty of Traffics, Belgrade

In this talk we shall give an overview of some classical facts about the essential connection between nonstandard probabilities and default reasoning (e.g. Lehmann-Magidor characterisation theorem for so called rational inference relations) and certain recent formalization techniques that allow formalization of default reasoning in decidable probabilistic logics.

we present new type of attack on availability of modern Web sites and clients. Attack is based on disproportion between allowed size of cookies on client and acceptable size of cookies that server will accept within single request (size of HTTP request header where cookies are stored). Two possible effects of presented attack are preventing client to access Web site and perform (D)DoS attack on server.

VI2. Artificial intelligence models and systems
Chair: Milan Milosavljević, School of Electrical
Engineering, University of Belgrade, SERBIA
Thursday, June 11, 2015, 12:30-14:30, Room 1C

VI2.1

DEEP LEARNING AND TRANSCENDENTAL IMAGINATION

Milan M.Milosavljević, Singidunum University, Belgrade, and also Faculty of Electrical Engineering, Belgrade University

In this paper we introduce unexpected connection between deep learning and very specific philosophical problem, so called transcendental imagination, introduced by Kant and further developed by Hegel and Heidegger. It is turn out that transcendental imagination corresponds to inner representation of a deep learner, which estabishes efficient representation during unsupervise learning in an autoencoding manner. We show that many statement of Kant and Hegel about transcendental imagination are very inspirative for understanding deep learning phenomena.

VI2.2

CHALLENGES IN EMOTIONAL SPEECH RECOGNITION

Milana Milošević, School of Electrical Engineering, University of Belgrade, SERBIA
Željko Đurović, School of Electrical Engineering, University of Belgrade, SERBIA

Speech emotion recognition as area of research in speech processing is generally analyzed by several reviews of literature and state of art papers. However there is no integral analysis of opened issues and decisions made by researches which can be discussed. This paper aims to cover opened issues and challenges in this research area. Opened questions are discussed by steps in process of emotional speech recognition which is following: emotional modeling, database construction, feature extraction and selection, classifier selection and application, and validation of results. For every step, several problems are addressed.

VI2.3

atCookies: HTTP COOKIES BASED ATTACK ON WEB SITES AVAILABILITY

Aleksandar Jevremović, Singidunum University, Belgrade, Serbia
Mladen Veinović, Singidunum University, Belgrade, Serbia
Marko Šarac, Singidunum University, Belgrade, Serbia
Nenad Ristić, Singidunum University, Belgrade, Serbia
Goran Shimic, Singidunum University, Belgrade, Serbia

HTTP cookies seem to be an inexhaustible source of vulnerabilities on World Wide Web. Well known attacks (based) on HTTP cookies are mostly focused on compromising confidentiality and integrity, while privacy aspect is the most popular issue these days. In this paper

VI2.4

APPLYING MACHINE LEARNING IN THE DEVELOPMENT OF FORENSIC TOOLS TO DETECT CIPHERTEXT

Saša Adamović, Singidunum University, Belgrade, Serbia
Vladislav Miskovic, Singidunum University, Belgrade, Serbia
Milan Milosavljević, Singidunum University, Belgrade, Serbia
Mladen Veinović, Singidunum University, Belgrade, Serbia
Dalibor Radovanović, Singidunum University, Belgrade, Serbia

In this paper, we use methods of machine learning to detect ciphertext. Today there are only forensic tools that detect ciphertext based on meta-data in file, where is the ciphertext located. Our task is to detect ciphertext without meta-data, based on the data structure. In this case, it is necessary to discover the characteristics by which it is possible with high accuracy detect ciphertext between other similar data structures such as ZIP, RAR, MP3, MP4, PDF and MPEG. Successful development of this method represents a significant contribution to the development of intelligent IDS system.

VI.2.5

ONE IMPLEMENTATION OF PROTOCOL FOR CRYPTOGRAPHIC KEYS DISTRIBUTION OVER PUBLIC CHANNELL

M. Tatović, Singidunum University, Belgrade, Serbia
S Adamović, Singidunum University, Belgrade, Serbia
M. Milosavljević, Singidunum University, Belgrade, Serbia

In this paper, we presented the design and implementation of cryptographic key distribution protocols over public channels. This protocol has its own source of randomness which is based on data from civil air traffic. Equivalent protocol scheme has been developed according to the theoretical protocol – "Satellite scenario". In this way, we have allowed both parties to generate symmetric keys without pre-shared secret. Keys generated on this way can be used with symmetric encryption (AES, DES). Performance of the proposed protocol was conducted with rigorous theoretical information analysis.

VI2.6

THE COMPARISON OF THE HYBRID WITH THE TRADITIONAL MODEL OF NEURAL NETWORKS IN THE PREDICTION OF THE STOCK MARKET INDEX BELEX15

Nataša Glišović, Department for Mathematical Sciences, State University of Novi Pazar, Vuka Karadžića bb, 36300 Novi Pazar, Serbia

In this paper, the model of the hybrid neural network model has been proposed, which represents the integration of the genetic algorithm in the neural network prediction. The aim of the research is that by the comparison of the proposed model with the traditional neural network model shows the advantages of the proposed model. Trough the error prediction mean absolute percent error (MAPE) the success of the proposed model prediction is shown. For the research, the data of the movement of the stock exchange index BELEX 15 have been used.

Quick Reference Timetable

Time	Activity	1A	1B (central)	1C	2	Kamin
Monday, June 08, 2015						
11:00-13:00	Sessions 1	AKI1	MEI1+ME1	AP1	ML1	RT1
13:00-14:00	Lunch Break					
14:00-16:00	Sessions 2	AK1	ROI1	API1	ML2	RT2
16:00-18:00	Sessions 3	AK2	ROI2	NTI1	ML3	RT3
18:15-20:00	Conference opening		Conference opening			
Tuesday, June 9, 2015						
8:30-10:30	Sessions 4	EKI1	ROI3	MT1	MLI1	RT4
10:30-12:00	Keynote talks 1					Keynote talks 1
12:00-14:00	Round Table 1					Round Table 1
14:00-15:00	Lunch Break					
15:00-17:00	Sessions 5	EKI2+EK1	ROI4	MTI1	TEI1	RTI1
17:00-19:00	Sessions 6	NMI1+NM1	AUI1	MTTS	TEI2	RTI2
19:00-20:00	ETRAN Assembly		ETRAN Assembly			
20:30	Conference Dinner					
Wednesday, June 10, 2015						
8:30-10:30	Sessions 7	ELI1	AUI2	MTI2+MT2	TE1	RT5
10:30-12:30	Keynote talks 2					Keynote talks 2
12:30-14:30	Round Table 2					Round Table 2
14:30-15:30	Lunch Break					
15:30-19:30	Excursion					
Thursday, June 11, 2015						
8:30-10:30	Sessions 8	MO1+MOI1	AUI3	EDU	EEI1	
10:30-12:30	Sessions 9	MO2+MOI2	AU1	VII1	EE1	ELI2+EL2
12:30-14:30	Sessions 10	MO3+MOI3	AU2	VII1	EE2	EL1
14:30	Conference closing					Conference closing